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FINAL ARGUMENT & RECOMMENDATIONS

Mackenzie Valley Pipeline Inquiry



Canadian Arctic Resources Committee

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SUBMISSIONS
AND
RECOMMENDATIONS

MACKENZIE VALLEY PIPELINE INQUIRY

CANADIAN ARCTIC RESOURCES COMMITTEE

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Ottawa, Ontario

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Cover Design: BB&H Graphic Communications Ltd.

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ISBN 0-919996-02-7

Canadian Arctic Resources Committee
1976 Publishing Programme

Preface

If Canada wishes...to soundly plan for the resource development of the North, it must pause long enough to design institutions that assure all segments of our society an effective opportunity to participate in decision making. The proposed northern gas pipeline provides both an excellent example of these problems and an excellent opportunity for the Canadian government to develop the decision-making patterns that will be followed in the future.

CARC National Workshop
on People, Resources
and the Environment
North of 60°, 24 May 1972.

From its inception in 1971, CARC has worked "to open a window on the North." A major component of our effort has been to promote public processes through which the merits of development projects could be openly considered before decisions to proceed were taken.

The Mackenzie Valley Pipeline Inquiry was an outstanding example of such a process. In our estimation it was the most important social experiment of the decade. CARC worked with the Inquiry from the preliminary hearings through to the final argument.

One of the major stumbling blocks was financial; it was not clear whether money would be available for such a massive undertaking. CARC members determined that participation in the Inquiry must be on a full-time basis and that considerable funding would have to be secured if CARC were to make an adequate representation.

The door to participation was opened when the federal government commissioned Justice Thomas Berger to conduct the inquiry into the impact of the proposed Mackenzie Valley gas pipeline.

Berger recognized that his mandate to consider the regional, social, environmental and economic impacts of the pipeline could only be carried out if northern people and environmental groups had an opportunity to participate. Funds were made available to the native organizations - the Indian Brotherhood of the Northwest Territories (IBNWT), Committee for Original Peoples' Entitlement (COPE) and the Council for Yukon Indians (CYI) - to engage legal counsel and to conduct field work in the communities. Moreover, since there were many concerns common to the natives and the environmentalists, the idea evolved of creating a joint research team under the management of the Canadian Arctic Resources Committee to provide scientific and technical information for these groups. This concept was approved by the Inquiry, funding was provided, and the Northern Assessment Group (NAG) was created. Russell Anthony, a Vancouver lawyer, and Alastair Lucas, a professor of law from the University of British Columbia, were retained to prepare CARC's case and assist in the work of the Northern Assessment Group.

In the summer of 1974, Dr. John Spence, formerly scientific advisor to the Cree during their struggle against the James Bay

hydro-electric development, became the director of the Northern Assessment Group. His first tasks were to hire office staff and to commission consultants from various disciplines to study the Arctic Gas application. Until the Inquiry opened in March 1975 an important aspect of NAG's work was the preparation of background material for the native organizations so that the local communities could become familiar with the pipeline proposal and its implications for their future. This information consisted of reports and analyses; and films illustrating the stages of pipeline construction, hydro-carbon processing, and the environmental impacts from existing pipeline and highway projects.

The Inquiry was split into four phases - the Geotechnical and Construction, the Environmental (living and non-living environment), the Social, and the Economic. The testimony of Arctic Gas and Foothills Pipeline Limited could be challenged either by CARC cross-examination or by the direct evidence of witnesses. NAG's work involved briefing counsel on topics and the selection and preparation of appropriate witnesses. Given the volume of highly specialized material, the job facing lawyers and researchers was formidable. During the Geotechnical and Construction phase CARC, the IBNWT and COPE relied mainly on cross-examination. Once the Environmental phase commenced, panels of witnesses were called to clarify or dispute previous testimony and to introduce new evidence. CARC itself called witnesses on a broad range of issues, and the recommendations of these witnesses became the basis for much of the final argument included in this volume.

In December 1975, Dr. Douglas Pimlott took over as director of the Northern Assessment Group. Dr. Pimlott had spent a year working as a CARC field worker with COPE in Inuvik and had investigated the

plans for offshore drilling in the Beaufort Sea. In January 1976, a special phase of the Inquiry was organized to examine the unique problems of offshore and onshore development in the sensitive ecosystem of the Mackenzie Delta. COPE and CARC worked together in the preparation and presentation of their case for the Delta phase. Evidence was called from scientists engaged in consideration of offshore drilling. These experts examined the potential impacts of drilling on the Beaufort Sea. Testimony also centred on the state of contingency planning in case of oil spills or blowouts.

At the conclusion of the Environmental phase of the Inquiry, NAG devoted its time to preparing the ground work for final argument. Specific recommendations and significant sections of testimony on various topics were distilled from the voluminous transcripts. These topics were distributed to the major interveners, including the Environment Protection Board, the Berger Commission staff and the Department of Indian Affairs and Northern Development for their use in final argument.

When Judge Berger began his southern tour to listen to citizens across Canada, the Northern Assessment Group provided background material to organizations such as the Canadian Nature Federation and The Society for Pollution and Environmental Control (SPEC) to assist them in their submission before the Inquiry.

In CARC's final argument before the Berger Inquiry, Chairman Andrew Thompson spoke of the long-term value of the Inquiry:

You once referred, Mr. Commissioner, to the prevalent view that says a decision on a Mackenzie Valley pipeline "should only be made by the

people in government and in industry; they have the knowledge, they have the facts, they have the experience."

Your Inquiry has put that proposition to the test and found it wanting. You have put other propositions to the test and found there is still a vibrant political life in this country. Your Inquiry has shown that if you treat citizens as equals and respect their procedural concerns they will respond in a positive manner. The Inquiry has shown that if you give citizens the time and the means to understand complex issues they will not only participate but will bring new dimensions and new insights to bear on technological and social problems.

It is for this reason that the Berger Inquiry will be remembered not as an isolated experiment but as a model for future decision making.

Edwards, Kenny & Bray
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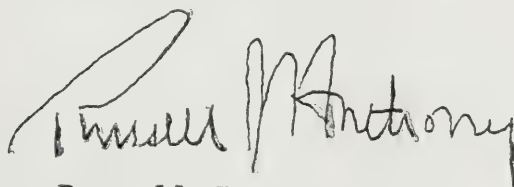
November 15th, 1976

Mr. Justice Thomas R. Berger
Commissioner
Mackenzie Valley Pipeline Inquiry
Resources Building
Yellowknife, N.W.T.

Dear Mr. Commissioner:

I have the pleasure of submitting the Submissions and
Recommendations of the Canadian Arctic Resources Committee.

Yours truly,



Russell J. Anthony
Counsel
Canadian Arctic Resources Committee

RJA/ah
Enc.

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SUBMISSION & RECOMMENDATIONS

of the

CANADIAN ARCTIC RESOURCES COMMITTEE

to the

MACKENZIE VALLEY PIPELINE INQUIRY

The Canadian Arctic Resources Committee (hereinafter also referred to as "C.A.R.C.") is pleased to present to the Mackenzie Valley Pipeline Inquiry (hereinafter also referred to as "the Inquiry") its submission and recommendations. The information used in the submission has been drawn from the transcripts and documents of the Inquiry by the staff and counsel of the Canadian Arctic Resources Committee and the Northern Assessment Group.

The Canadian Arctic Resources Committee, as the major environmental intervener before the Mackenzie Valley Pipeline Inquiry, has, of course, an interest in all of the activities and issues that may have an impact on the biological and physical environment. C.A.R.C. actively participated in the presentation of evidence and in cross-examination of witnesses called by other participants covering the whole range of activities anticipated to have an environmental impact. In its final submission, C.A.R.C. has concentrated its recommendations on only some of the environmental issues raised by the proposal to build a Mackenzie Valley gas pipeline. It is expected that the various participants, and in particular the staff of the Commission Counsel, will have the combined resources to cover the broad range of issues presented to this Inquiry. For its part, C.A.R.C. has concentrated on the major environmental issues and those of a more general nature that are unlikely to be addressed by the other participants. As a "public interest group", the Canadian Arctic Resources Committee feels it has a responsibility to highlight the major environmental issues and to speak to this Inquiry about those general issues of concern to many members of the Canadian public. Our concentration on these issues should not be interpreted as suggesting that the other environmental issues are of a lesser concern. Rather, it should be recognized as an attempt to focus attention on those issues uniquely of concern to a public environmental group.

STRUCTURE OF PRESENTATION

C.A.R.C. has structured its recommendations in terms of the major environmental concerns presented by the proposal

to construct a natural gas pipeline in Canada's Western Arctic. One will find, therefore, under the environmental heading "Fish" a series of recommendations dealing with the range of activities or potential environmental problems that might impact on the fish resource. The usual topic headings describing the pipeline activity (river crossing, sedimentation, methanol and so on) will be identified and dealt with as they relate to environmental impact on fish. This method of structuring the final argument will, hopefully, assist the Inquiry to appreciate the impact of a wide range of activities on the particular environmental species being considered.

Each environmental concern identified contains introductory remarks outlining the nature of the problem and the significance of the environmental issues raised. Thereafter, will follow a series of recommendations to this Inquiry flowing from an identification of the environmental concern.

In order to assist the Inquiry, transcript references have been provided with respect to most, but not all, of the recommendations. In each case, the transcript reference is clearly set out opposite the recommendation or comment. It is important to note that the citations are not meant to indicate that the person cited actually made the specific recommendation. In many cases the witness cited was merely providing the factual evidence that led C.A.R.C. to make the recommendation indicated. In those situations where no witness or a series of witnesses have raised issues leading to recommendations, merely the page number has been cited.

Throughout, the term "applicant" refers to either/or both of the current applicants to build a natural gas pipeline, depending on the context. The term "government" shall mean the Government of Canada unless otherwise indicated and the word "Authority" or "Pipeline Authority" shall refer to whatever agency is given the responsibility for implementing and enforcing pipeline regulation.

ONUS AND STANDARD OF PROOF

It is submitted by the Canadian Arctic Resources Committee that the onus of proving that the proposal to build a Mackenzie Valley gas pipeline can be successfully carried out within acceptable impacts rests throughout on the proponents of the scheme. The applicants must accept the responsibility to demonstrate to this Inquiry, to the agencies of government and to the Canadian people that they can construct the pipeline in the manner and within the timeframe they propose and that they understand and can control the environmental and socio-economic impacts within acceptable limits. This

obligation is clearly suggested in the Government of Canada 1972 Pipeline Guidelines. If the applicants cannot do this, they must not be permitted to proceed.

Nor should the standard of proof required by this Inquiry be merely a balance of convenience or even the balance of probability. In many instances the applicants are dealing with crucial issues, in effect, issues of life and death. The ability to safely construct a chilled buried gas pipeline, the survival of the Porcupine Caribou Herd, the environmental integrity of the Mackenzie Delta, and the welfare of the residents of the Canadian North are some of these issues. When considering the evidence being presented by the applicants and others on these vital issues, this Inquiry should apply a higher standard of proof. Demanding anything less could place in jeopardy the survival of integral elements of the Canadian heritage.

This Inquiry has had the occasion to listen to evidence covering a wide spectrum of probative value. You have heard evidence based on sophisticated studies, scientific conjecture and personal experience. You have received "hard data", both at the formal hearings and at the community hearings and you have received the speculations and generalizations of both expert and layman. It is for you to decide on the relative weight to be placed on the evidence you have heard. We would submit, however that in many of the most important environmental issues before you there are no recognized "experts". C.A.R.C. would urge this Inquiry, in considering these issues, to pay particular attention to the evidence of the residents of the North, particularly the native people who have learned to understand and live with the environment. C.A.R.C. has presented before the Inquiry a number of eminent and qualified scientists who have spoken of their studies and provided their recommendations. Many of the recommendations submitted by C.A.R.C. are based on the evidence of these experts and of experts called by the other participants. However, to understand the importance of the environment and of environmental protection we would ask this Inquiry to also consider and act upon the submissions and recommendations of those who, from personal experience, can teach us about this fragile land (120,18333 - 35).

If the applicant is unable to satisfy the onus placed upon it, then the Inquiry should hold that the application is deficient. In some situations, the deficiencies shall be of such great magnitude or cover such a wide range of issues that this Inquiry should hold that there is insufficient evidence to properly assess the impacts or make appropriate recommendations. In those cases the Inquiry should hold that the pipeline should

be built, if at all, only upon completion of the appropriate further studies and a proper evaluation of those studies. C.A.R.C. has, in many of its submissions, provided a list of further studies and identified knowledge gaps that it will urge be examined and, in some cases, be completed as a precondition to the applicant being granted approval to proceed with its pipeline application.

OVERVIEW OF THE MACKENZIE VALLEY PIPELINE PROPOSAL

In May 1975, the Canadian Arctic Resources Committee convened a conference in Ottawa to ask the question "Gas from the Mackenzie Delta: Now or Later?" Well informed Canadians argued for delaying the pipeline on the grounds that frontier gas was not a priority and that the financial, economic, social and environmental impacts would all be softened by delay. Reading that conference report today, one sees that in the spring of 1974 there were still many unknowns. Despite the unanimity with which the conference speakers advocated postponement of the pipeline, C.A.R.C. withheld judgement. The issue was too important to decide before all the facts were known. C.A.R.C. has participated throughout this Berger Inquiry with the same suspension of judgement.

Now, at the conclusion of this hearing, those of the Committee responsible for C.A.R.C.'s day to day participation in the Inquiry have made up their minds.

We conclude that the Mackenzie Valley gas pipeline is dead. It is dead because the Delta gas is not now needed in Canada, because the project is too costly, because its social and environmental impacts are intolerable and because there are alternatives which will better serve the nation.

We are not asking you, Mr. Commissioner, to make such findings because we know that your terms of reference do not include a recommendation for or against the pipeline. But the order-in-council does require you, in your own words (Transcript, p. 31608), "to report on the social, economic and environmental impact of the proposed gas line and energy corridor." That task is essentially one of evaluating tradeoffs. The important question is whether the acknowledged adverse social, economic and environmental impacts are so serious as to call in question the project itself. The conclusion you reach will very much depend on your evaluation of the need for the pipeline. In our estimation the applicants have not shown a need for the pipeline. Our conclusion is based on many factors.

First, the gas is not needed in southern Canada until late in the 1980s, and may not be needed well into the 1990s because the expiry of the gas export contracts will enable Canadian gas then being sold in United States' markets to be diverted to Canadian markets at that time. Alternatives are available to Canada to bridge any gap between the late 1980s should shortages develop and the 1990s when the export contracts terminate. An obvious one is for Canada

to negotiate a phasing out of the export contracts so that some gas can be diverted to Canadian markets before 1990 in exchange for extended deliveries to the United States beyond the expiry dates of the contracts. This tapering off of the export deliveries could be designed to match increasing Canadian demand. In the United States, the tapering off of Canadian supply could be offset by deliveries of Prudhoe Bay natural gas if the El Paso L.N.G. system or the Alaska Highway pipeline system were constructed in the meantime.

Other alternatives involve switching to different energy sources. No one is arguing that Canada faces an energy shortage. Alternatives are available, and although these will be costly, they will not be as costly as Mackenzie Delta gas at today's equivalent of \$3.00/mcf.

Two years ago Arctic Gas was predicting natural gas shortages as early as 1979. Recently they are acknowledging that shortages won't occur until 1981 or 1982. We believe that shortages won't appear until 1988 or 1989 because the trends which have caused Arctic Gas to lengthen their forecast period of self-sufficiency are more deeply rooted than they appreciate. These are the trends towards increased southern supplies and decreased Canadian demand brought about by higher field prices and higher market prices. Dr. Wood of the M.I.T. study team on energy reported to the Calgary conference on "Government Involvement in the Energy Industry" (October 1976) that their data show considerable elasticities in supply and demand for oil and gas. He stated that in his opinion the United States' national security concerns about energy independence would be alleviated simply by pricing oil and gas at world levels. We have already seen deliverability enhanced in both British Columbia and Alberta gas fields as a result of higher producer prices, and we have the experience of growth rates in demand for natural gas in Canada of less than 1% for the past two years owing in part at least to higher prices.

The other factors that are enabling us to predict that Canada will be able to meet its natural gas needs late into the 1980s are the success attendant on the federal government's conservation programme and the failure of our economy to recover as rapidly as expected.

In any event, the nature of a shortfall in natural gas deliveries must be appreciated. It is presented in the media as if a shortfall were a catastrophe which would overshadow all other calamities. In fact, there has been a natural gas shortage in the United States for the past three years,

with some regions showing shortfalls as high as 25%. Yet there is no evidence of any serious discomfort or dislocation south of the border, and their economic performance has exceeded our own. We are not advocating shortfalls, but we want to make it plain that in our view no catastrophe is threatened in southern Canada that can in any degree match the calamity that threatens the native peoples in the north if the pipeline is proceeded with immediately.

Later in our argument we will show you why environmental impacts justify delaying a Mackenzie Valley natural gas pipeline as long as possible, and you will hear from other interveners the reasons why delay will serve the interests of a just settlement of native land claims and of preserving the life and culture of native communities in the region. Now, we wish to state our view that delay will provide advantages to the nation in both an economic and a political sense.

Arctic Gas has announced that it cannot finance the pipeline without government subsidy. This is another way of saying that the project is not economic at this time. Ordinarily one would expect those in industry and finance to be opposed to a non-economic project because they are usually the spokesmen for free enterprise and against government intervention. Yet now we hear them clamour for a project which requires that government strengthen its control. Where is the virtue in this aggregation of multinationals clinging to the lifeboats of the federal government? Surely the wise course is to wait until the project is economic and can be financed on its own merits. Canada has a multitude of capital projects competing for scarce resources. Our economic well-being will be served by ordering priorities rigorously, and our political well-being will be served by avoiding government intervention except where absolutely necessary.

It is because we believe that the Mackenzie Valley gas pipeline proposals are dead that we have chosen to address our arguments to the longer range issues that face Canadians in the north. We will file with the Commission our detailed analysis of environmental impacts and our recommendations of measures to avoid and minimize them, but we do so with the rueful awareness that they will likely serve merely as a curiosity when the first northern pipeline is built in Canada.

This is not to say that the three years of the Berger Inquiry have been a waste of time and money, for this Inquiry has done more to open a window on the north than any other event in Canadian history. Those thousands of witnesses at community hearings have had a political awakening while their compatriots in the south have had their eyes opened

to the richness of the northern landscapes, peoples and resources. Much is expected! You, Mr. Commissioner, have aroused those expectations. Our summation is that the enormous effort of this Inquiry would be wasted if those expectations are not met. We realize that you must report to the government appropriate terms and conditions that ought to be imposed on any right-of-way that might be granted for a pipeline, but you, like us, should regard this exercise as the least important part of your effort. We challenge you to point the direction for northern Canada.

This task requires that you define where we have started from. You have heard the history of increasing contacts between native persons and Europeans commencing with the fur traders and the whalers and ending with the explorationists seeking oil and minerals. You have seen the villages and communities and heard the claims to aboriginal rights and cultural self-determination. You have the measure of environmental impacts in the three main geographical regions which a pipeline would affect - the North Slope, the Delta and the Mackenzie River Valley. Documentation filed with the Inquiry tells of the development of government in the north and you can judge the extent to which it is following the precedent of evolution from colonial status to full self-government established for the provinces in southern Canada.

Upon this biography of the north you must impose the advent of the massive resource developments of the last two decades. These developments have been characterized by monolithic co-venturing between industry and government which, however well intentioned, can only be seen as conspiratorial by those who believe that other values are equally as important as rapid exploitation of natural resources. Some of these values are the alternative uses that will be prejudiced by the oil and gas fields and the pipeline: other values are the less tangible ones of openness and accountability in a democratic society.

We ask you to conclude that Canada in 1976 is at a point when clear choices must be made between exploitation of resources now versus conservation for future generations, between developments that benefit northerners versus those that benefit southern Canadians, and between cultural survival of native northerners versus the self-government ambitions of the non-natives.

In these key policy areas, we commend to you the following recommendations within your mandate to report on the social, economic and environmental impact of the proposed gas pipeline and energy corridor.

Natives and Non-Natives

There are many unanswered questions about native land claims. While many, and probably most Canadians are anxious to meet the proper claims of native peoples, they are without guidance as to the nature of these claims and as to the possible ways in which a settlement can be achieved. With negotiations in prospect, you, Mr. Commissioner, may be diffident about speaking out. But you have had a unique opportunity to understand the issues and you now have a unique opportunity to educate your fellow Canadians. Without an understanding public no negotiated settlement will offer much promise of an abiding accommodation. While conventional procedures would shroud negotiations in secrecy, that practice seems highly questionable when the nature of what is at stake is fully realized. It is not a private deal over land -- it is the future cultural, political and legal relationships between natives and non-natives in the north that must be determined, and all Canadians must be privy to these deliberations. The folly of secrecy has already been exposed by the interruption of the Yukon negotiations.

What you, Mr. Commissioner, can tell the Canadian public is your assessment of the following questions:

- (i) Do native northerners have a sufficient understanding of the issues to say YES or NO to a pipeline?
- (ii) Do they oppose the pipeline only until land claims are settled, or do they oppose it because they oppose the changes that development will bring?
- (iii) Are the views of native peoples widely held through all regions and all age groups or are there identifiable groups in favour of or opposed to the pipeline?
- (iv) Who speaks for the native northerners? Are the native organizations being given a full opportunity to represent native interests?
- (v) Are native peoples capable of dealing with a land settlement now and if not, what kinds of social and political developments must take place before a settlement and when?
- (vi) Is there a set of interim measures that can be taken to enable necessary land planning and development to proceed while negotiations towards settlement of land claims proceed?

- (vii) What are the philosophical, political and legal justifications for the Dene claim to self-determination as distinct from the purely legal claim to aboriginal rights, and what are the possible alternative outcomes of these differing approaches to settlement?
- (viii) What kind of negotiating mechanisms are most likely to expedite a proper settlement of land claims, having in mind that the negotiating process established in the case of the Yukon natives has proved unworkable?

Present and Future Generations

The subject of energy conservation has many dimensions and, not surprisingly, it has many meanings for this Inquiry. First, it is now acknowledged to be the cheapest means of meeting future energy requirements. Now that the applicants are telling the National Energy Board that the current cost of delivering northern natural gas to Toronto will be \$3.00/mcf compared to the current price of approximately \$1.25/mcf, it is obvious that a good deal of energy conservation will be practised in preference to buying northern gas. This means that the need for northern natural gas will be further deferred, enabling us to conclude that a postponement of the project is good for Canada.

A second aspect of energy conservation must be assessed on a longer time scale. So long as the consumption of oil and gas continues at current rates, it is generally agreed that world supplies of hydrocarbons will be approaching exhaustion in the first quarter of the next century. One can assume that changing technology will provide our children with as rich an energy system as we now enjoy, but such an assumption is an act of faith. A wiser and more generous course would be to begin conserving our hydrocarbon resources now. Seen in this light, delaying the natural gas pipeline would be a moral act even if it meant some shortage of natural gas supplies in the meantime.

There is an even more profound aspect of conservation: we refer to conservation of species and of natural systems. If you believe that our grandchildren and great grandchildren have a right to the preservation in their natural state of the caribou, the last of the great grazing herds that once included the buffalo of North America and the wildebeast of Africa, then the pipeline link across the North Slope of Alaska and the Yukon must not be built. You cannot be sure that the oil and gas field operations in the Delta and the Beaufort Sea will not ultimately imperil natural

systems on which the earth's climatic balance depends.

To approve the pipeline on the applicants' timetable is to shrug off the interests of future generations in service of a mindless economic imperative that says that having to do without an extra cubic foot of gas is the highest form of mischief we can suffer.

Northerners and Southerners

As southerners, the members of C.A.R.C. have no hesitation in asserting their right to be heard on issues affecting the future of northern Canada. What we don't have a right to do is to impose the needs of southern Canada for energy resources on the north without taking into account northern needs and aspirations. You have evidence before you as to the regional, social and economic impacts of the proposed pipeline and should report the consensus you find on the broad question of northern attitudes to development.

Federal and Territorial Governments

Ten years ago the Carrothers Commission reported on the development of self-government in the Northwest Territories. One of its recommendations was that there should be a follow-up report in a decade. In many ways the Berger Inquiry is that follow-up. You, Mr. Commissioner, have had an unparalleled opportunity to observe government in action in the north. You are familiar with the recommendations of Dr. Carrothers and his fellow commissioners and you are aware of the important steps that have been taken, such as the establishment of a territorial capital at Yellowknife and the relocation of many government services there to implement their recommendations. In the context of managing social, economic and environmental impacts, your assessment of the appropriateness and competence of government services and operations could provide the direction for the next decade.

The issues are enormously far reaching. Is the territory ready for further major steps towards self-government? What should they be? Is a typical southern province a suitable model for the territory? Should natural resources and their management be reserved for federal ownership and control as in the case of the prairie provinces from 1905 to 1930? How are native land claims and the claim to Dene self-determination to be stitched into the fabric of government? How can a project like a Mackenzie Valley natural gas pipeline be managed efficiently so that social, economic and environmental impacts are controlled and minimized without debilitating local government institutions and dislocating territorial and federal government services?

How can resource management and land planning decisions be made in the interim when permanent institutions are evolving?

It would be easy to say that these formidable questions transcend the Inquiry's mandate. But that makes them no less the really important issues we face. We urge you to see your mandate broadly, for no one is in a better position to give guidance and direction.

The Citizen and the State

Above all else, C.A.R.C. stands for the idea that citizens in a free society have the privilege and duty to become well informed about the nations affairs, to make their views known and to call their political leaders to account. The system breaks down, and democracy with it, if information is not readily available, if opportunities to present viewpoints are not provided, if decisions are secret, and if the politicians lose control over the bureaucracy. All of these deficiencies have been acutely present in the north. Particularly since Canada embarked on a series of major energy projects in the '70s, government and industry have closed rank and used the claims of scale and complexity to exclude the citizen and to bypass Parliament.

Information, which is difficult to come by at the best of times in the Canadian system, is more restricted in the north where distances are vast and remoteness impedes the normal distribution of news through the media. The vestiges of colonial government and the fledgling nature of local institutions, together with the restricted flow of information, mean that the opportunities to present viewpoints are extremely limited. In the area of natural resources, which lies outside the purview of the territorial government, there is no opportunity for debate or argument other than provided in Parliament itself, and Ottawa is far away, with only two sitting members from the territory. In any event, most matters affecting natural resources are provided for by regulations which do not get before Parliament. You have heard evidence as to the opportunities in the Territorial Council for debate about amendments to the Land Use Regulations (Graham Beakhust, 199,31520-23) and you are aware that the Northern Inland Waters Act is the one exception where a statute of Parliament calls for hearings to be held in the Territory prior to the issue of a water licence. (McLeod, 196,30824). The witnesses left no doubt that in these isolated examples, bureaucrats are reluctant to afford citizens an opportunity to be heard.

The closing of the ranks by government and industry with respect to northern natural resource developments has been documented in two recent publications filed with the Inquiry - Edgar Dosman, The National Interest: The Politics of Northern Development, 1968-75, McClelland and Stewart Limited 1975; and D. Pimlott, Oil Under the Ice: Offshore Drilling in the Canadian Arctic, C.A.R.C., 1976.

The restricted flow of information, the lack of opportunities to be heard and the secrecy of decisions all contribute to a breakdown of political control over the bureaucracy. When Parliament too is ineffectual in its supervision, there is real danger to the body politic. That is precisely the situation as we see it, and C.A.R.C. has confronted Members of Parliament with the charge that they are failing to discharge their responsibilities. The reason for the establishment of this Inquiry is in large measure due to Parliament's failure to establish northern policy. Appearing before the House of Commons Standing Committee on National Resources and Public Works on 3 February 1976, we argued that if parliamentarians were given the financial and logistic support necessary "to watchdog the official side of government" inquiries of this scale would seldom be necessary.

The relevance of this recital of the failure of our democratic institutions is to underline how significant has been the holding of the Inquiry itself. It has provided both northerners and southerners a major opportunity to gain information and to present their views, and the ultimate decision about a pipeline will be an open one fully in accord with democratic principles. But this Inquiry must not be recorded in history as one flash of brilliance and light in an otherwise darkened landscape.

Surely one of the most important recommendations you can provide, Mr. Commissioner, is a formula for public participation in future decision-making about natural resource developments in the north. Alternative natural gas pipelines will have to be considered. In time there may be an application for an oil pipeline. Major hydro-electric projects are on the drawing boards. Highways are planned to complete a transportation network with further railroad extensions northward. New mines as large as an Anvil or a Pine Point are in the portfolios of the major resource companies. All of these justify impact assessment and public review as much as the gas pipeline. C.A.R.C. opposes the environmental impact assessment procedures now conducted by the federal government as in the case of drilling for oil in the Beaufort Sea so long as they remain "in-house" and without public participation.

The question, simply put, is whether the north will slip back behind the bureaucratic barricades or whether the Berger Inquiry will be a landmark for the future. This is not to suggest that each resource decision must be prefaced by the full paraphernalia of this Inquiry. But its essence must be defined, and you, Mr. Commissioner, are in the most favored position to recommend how future projects should be assessed as to their social, economic and environmental impacts.

In our view the essential elements of your Inquiry are as follows:

- the detailed presentation of environmental and social impact evidence and rigorous testing of that evidence through cross-examination in formal hearings;
- the discovery process whereby parties, as well as the government, were required to disclose and produce studies and reports in their possession relevant to the Inquiry;
- the two level feature of the Inquiry whereby, in addition to the formal hearings, there were informal community hearings at which people could speak in their own way and in their own languages;
- the communication of issues and evidence to the public through wide multi-lingual media coverage and southern city hearings; and
- the support of "third party" appearances by native organizations, northern municipalities and environmental groups in the formal hearings so that rigorous examination of the issues from varied points of view would be assured.

We ask you to recommend to the government that hearings including these essential elements be convened to inquire into each major new project proposed for northern Canada. In particular, a Polar Gas pipeline proposal must be examined by an independent public inquiry to avoid the conflict of interest situation that will result because the applicant will in all likelihood include federal Crown corporations as major participants. Such an inquiry need not be as wide in scope or as lengthy in duration as this Inquiry because there will be the findings and recommendations of this Inquiry to build on.

In particular, an inquiry into the environmental, social and economic impacts of an Alaska Highway delivery system for Prudhoe Bay natural gas can be conducted in a substantially abridged timeframe because much of the evidence received by this Inquiry will be relevant and need not be repeated.

It has been argued that public inquiries are a waste of time and money. Ministers and their departments, abetted by industry, will be tempted to proceed without them as has happened in the case of drilling in the Beaufort Sea. We can only repeat our warnings of the danger. Nothing is more certain to produce alienation and apathy than giant technological projects requiring large capital expenditures and vast public and private bureaucracies. Nearly one hundred years ago Lord Bryce talked about "The Fatalism of the Multitude - the sense of insignificance of individual effort, the belief that the affairs of men are swayed by large forces whose movement may be studied but cannot be turned." This fatalism could spell the end of parliamentary government. You, Mr. Commissioner, once referred to the prevalent view that says a decision on a Mackenzie Valley pipeline "should only be made by the people in government and in industry; they have the knowledge, they have the facts, they have the experience."

Your Inquiry has put that proposition to the test and found it wanting. You have put other propositions to the test and found there is still a vibrant political life in this country. Your Inquiry has shown that if you treat citizens as equals and respect their procedural concerns they will respond in a positive manner. The Inquiry has shown that if you give citizens the time and the means to understand complex issues they will not only participate but will add new dimensions and new insights to bear on technological and social problems.

In time, as populations increase and as social and political institutions gain strength in the north, there will develop more routine systems for planning and authorizing land uses and natural resource developments. These new systems will undoubtedly build on the procedures that this Inquiry and later inquiries adopt. Therefore, in our view, the procedure established in this Inquiry can provide a precedent for responsible self-government that will endure far into the future life of the territories.

Beaufort Sea and the Mackenzie Delta Experience

C.A.R.C. is concerned, Mr. Commissioner, lest your report should serve merely to obscure the real issues facing Canadians. Should it deal only with the pipeline, it would surely have that effect. The opportunity will have been lost to prove that Canadians have a more noble aspiration for the north than merely to exploit its resources, and a more abiding faith in themselves than merely to leave policy making to government and industry. These alternatives are, as it were, waiting in the wings. When the Berger Inquiry leaves centre stage, the model of Cabinet approval of drilling in the Beaufort Sea is ready to take its place. That model, characterized by haste, secrecy, and by single minded exploitation, is fully exposed in Dr. Pimlott's book Oil Under the Ice: Offshore Drilling in the Canadian Arctic.

There is even the risk that your report will lend legitimacy to the Beaufort Sea procedures. However tentatively, you have accepted testimony as to the environmental risks and hazards attendant on deep sea drilling, just as you have heard witnesses on the environmental impact of production facilities and gathering lines in the Mackenzie Delta. Surely these were not merely exercises in public relations. Unless your report criticizes the procedures by which these projects have been approved, it will be taken that they have a stamp of rectitude.

We recommend that you assess the effectiveness of the research programme that preceded the commencement of drilling in the Beaufort Sea; comment on the environmental assessment procedures adopted for the Beaufort Sea and the Mackenzie Delta facilities; and suggest follow-up procedures that will ensure incidents like the recent blow out at the Dome-Hunt well will be openly investigated.

The Environment and Industrial Development

All of the relationships previously discussed bear on the relationship between the environment and industrial development, for until man can govern himself, he is not likely to manage the environment well. Since government in the north is so embryonic and tenuous, with major relationships undefined, it is obviously wise to postpone industrial development that can be predicted to have adverse impacts on the environment.

In our opinion, the adverse impacts of constructing a pipeline across the north slope of Alaska and the Yukon, and

across the Mackenzie Delta, are so severe as to clearly outweigh any advantages of such a routing. We will provide our detailed analysis of these adverse impacts shortly. Meanwhile, we state our view that an alternative means of delivering Prudhoe Bay natural gas to United States' markets be utilized.

There are also serious environmental concerns about pipeline in the Mackenzie River Valley. Should an oil pipeline be accelerated because of construction of a gas pipeline, the hazard of major oil spills carried down the river into the delta, as well as all the impacts identified with construction and related activities, will also be accelerated. Cumulatively these justify delaying approval of the natural gas pipeline unless its need is conclusively demonstrated as a national imperative. This need has not been demonstrated.

In any event, it is common sense that alternatives be explored. We ask you, Mr. Commissioner, to recommend that the alternative of a natural gas delivery system to southern markets from the Arctic Islands be fully investigated and publicly reviewed alongside the Mackenzie Valley proposals. Such a project might better meet Canada's energy and economic priorities than the Mackenzie Valley pipeline, even apart from consideration of the many adverse social and environmental impacts of the latter. Should it be true, as we believe, that the timetable for the Mackenzie Valley proposals is really dictated by the needs of United States' customers for Prudhoe Bay natural gas, then that gas can find its way south by one of the alternative routes now before the United States' regulatory tribunals.

EXPERIMENTING ON THE NORTH

A. GEOTECHNICAL, ENGINEERING AND CONSTRUCTION

C.A.R.C. as an environmental intervener has, throughout the Inquiry, participated in and taken great interest in the geotechnical, engineering and construction phases of this Inquiry. Though major portions of the proposed route were relocated during the course of the Inquiry and many of the specific techniques and procedures to be employed were not known, the technical phases of the Inquiry were an important background to predict and evaluate any potential environmental impact of the pipeline proposal.

Canada's Arctic is our last frontier. While there may be experience with pipeline construction in other areas, where the question of pipeline construction in the fragile northern environment is concerned, we must approach as neophytes, largely ignorant and subject to physical and biological constraints not previously encountered. We must, therefore, approach construction of a pipeline in Canada's Arctic humbly and cautiously.

C.A.R.C. will not be presenting detailed recommendations concerning the significant geotechnical problems raised by the project. Rather, we bring to your attention a series of geotechnical, engineering and construction concerns that are crucial to an understanding of the environmental impact of the proposed Mackenzie Valley pipeline. In our view these crucial issues have not been satisfactorily resolved. The onus is on the applicant to advise this Inquiry of what it proposes to do and satisfy those responsible for examining the impact of their proposal that the preventative and remedial measures are practical and will work. With respect to a great number of major geotechnical and engineering issues posed by construction of the first chilled, buried gas pipeline in permafrost the onus has not, in our view, been satisfied.

The Canadian Arctic Resources Committee is forced to conclude after reviewing the vast amount of highly sophisticated yet often contradictory evidence, that the applicants, in order to build the pipeline within the timeframe proposed, are willing to use the last Canadian frontier as an experimental ground to prove their technology. Time and time again throughout this Inquiry the geotechnical witnesses were forced to rely on formulae, models and southern experiences unsubstantiated by actual northern field experience to explain and justify the geotechnical conclusions they have drawn. The northern test facilities used were representative of only a very small portion of the terrain encountered by the proposed pipeline route in the north (22,2560-2; 27,3293-308),

the Calgary test facilities have proven suspect in issues of great importance (195,30584 - 5) and even the pipeline applicants themselves have disagreed on their ability to construct the pipeline within the timeframe proposed (195,30448 - 30680). A number of critical issues remain unresolved.

This Inquiry does not have adequate information before it on a number of key geotechnical issues. It would be the height of folly to allow the construction of the pipeline to proceed at the present or, in fact, under any timeframe, without first requiring the applicants to demonstrate that all major geotechnical, engineering and construction problems have been solved. Because the applicants have been unable to do so to date, the Canadian Arctic Resources Committee submits that the Inquiry recommend to the Government of Canada that it require resolution of the following issues in particular, as a pre-condition to proceeding with an application.

(a) FROST HEAVE AND FROST BULB

The issues surrounding the question of frost heave and frost bulb, particularly in the areas of discontinuous permafrost, have been a subject of major controversy before this Inquiry. (Clark and Slusarchuk, Vol. 20 - 29; Adams 47,6112 - 13; Williams, Vol. 68 - 69; Arctic Gas 73,10944 - 47; Zoltai, 101,15477 - 78; Arctic Gas, 195,30584 - 5). This is as it should be, given the state of the art at the present time. While the safety of any proposed pipeline is undoubtedly an item to be considered by the National Energy Board, it is a matter that is also of central concern to this Inquiry. If this Inquiry must evaluate the potential environmental impacts of a buried, chilled gas pipeline it must, as a pre-condition, know in detail, the protective and remedial measures to be employed. It is up to this Inquiry to determine whether it has sufficient evidence to establish that the pipeline can be built as the applicants proposed and that the protective measures they proposed will be effective.

Questions of frost heave, differential heave in discontinuous permafrost and fen areas, shut-off pressures, limits for chilling, surface and sub-surface drainage are issues of great environmental importance. In our view, the answers have not been convincing. The position taken initially was that adequate shut-off pressures could be obtained to prevent frost heave by the utilization of basically two techniques, deeper burial and a berm. Now that the original calculation for shut-off pressures has been shown to be faulty, the use of these techniques may be in question and the use of other remedial techniques, such as removal of frost-susceptible

soils, has not been fully assessed. Although Arctic Gas has stated that it is satisfied the various remedial measures will work even though it has not determined where and how they will be employed along the pipeline route (199,31487-96) these techniques have not been considered and field tested given the expected new cut-off pressures.

This Inquiry should not merely accept the comments of counsel for the applicants that these remedial measures will, in fact, work. As was pointed out by the Environment Protection Board (Adam 47,6304-13) the measures designed to prevent frost heave, called "protective measures" are the same measures that are expected to be used by the applicant in the event the frost heave does occur and "remedial measures" are required. One has reason to be wary when protective measures are recycled as remedial measures.

Major questions remain to be resolved. We submit the applicant has not demonstrated that its proposal to ensure surface drainage or sub-surface drainage through the frost bulb by use of an insulated pipe will in fact be successful (Adam - 107,16348-50). Given the importance, in particular, of sub-surface drainage to the fish resource where over-wintering areas of fish are located downstream of a pipeline crossing, this issue must be resolved before conclusions as to the environmental impact of the project can be drawn.

Given the new shut-off pressure requirements, can one say with confidence that the river crossing techniques suggested by the applicant will in fact be adequate? Since the remedial measures at river crossings are more limited and may demand unacceptably deep excavations there is every reason to demand a thorough re-evaluation of each river crossing. (73, 10826). Such re-evaluation may require reconsideration of above-ground crossings. If above-ground crossings suddenly become feasible, a different series of environmental concerns are raised. These concerns have not been the subject of evidence before this Inquiry and their impact cannot be determined. (80,11924)

The limit of chilling has similarly been the subject of controversy although it is central to a determination of the environmental impact of the pipeline proposal. Arctic Gas, Foothills and the Environment Protection Board have all three presented evidence on where chilling of the gas should cease in the discontinuous permafrost zone. None of the three entirely agrees on either location or methodology. This matter must be resolved before the actual impact of the pipeline on the environment can be determined.

RECOMMENDATIONS

1. This Inquiry conclude that there is not sufficient evidence to determine the environmental impact of a chilled, buried gas pipeline because the questions of the nature and extent of anticipated frost heave and frost bulb problems have not been determined. Until there is evidence demonstrating that the problem of frost heave has been fully and accurately understood and the remedial measures proposed have been tested in field experiments covering the broad range of conditions to be encountered, no application for a buried, chilled gas pipeline should be entertained.
2. The use and success of remedial measures proposed by the applicants, particularly those proposed to ensure sub-surface draining through the frost bulb, have not been adequately demonstrated. Because of the critical importance of this technique to impact on the fisheries resource this technique must be studied in great detail and no conclusions of environmental impact on the fish resource can be drawn until this information is available and evaluated. (Hayden - 100,15306; Millen - 104,15878; Adam - 107,16349 - 50)
3. There is insufficient evidence to allow this Inquiry to determine the appropriate methodology or establish the location for the limit of chilling. Because of the importance of this matter in evaluating the environmental impact, particularly in drainage and erosion control in the discontinuous permafrost zone, no conclusions on the environmental impact of the gas pipeline are possible until this matter has been further studied and evaluated. (80,11816; 62,8771; 65,9531 - 48)

(b) SNOW ROADS

With rare unanimity the environmental witnesses appearing before this Inquiry have agreed that the environmental impact of the proposed pipeline would be dramatically increased if construction of the pipeline was accompanied by road access. All parties were in agreement that no road access should be maintained along the pipeline right-of-way, particularly on the north slope of the Yukon. Hence, the success of the proposed use of snow roads to facilitate the movement of men and equipment during the construction season is of crucial importance.

Snow roads of the standard required to handle the volume and weight of the anticipated traffic for pipeline construction have yet to be adequately tested throughout the range of seasons and snow conditions anticipated. Neither have the snow harvesting or snow manufacturing techniques been demonstrated in field testing to produce the volume of snow that might be required. The long-term and indirect effects of winter roads have yet to be evaluated (Bliss - 46,6130).

The fear has been expressed that there may be problems with the use of snow roads in certain terrain and gradients and, most significantly, in areas of high ice content soils, such as the Yukon north slope. (Clark - 80,11928; Adam - 107,16350 - 51). On the basis of experience in Alaska, evidence has been presented that maintenance of snow roads for the construction season proposed, given the snowfall of the area, has not been satisfactorily proved. (Weedon - 54,7546; Norton - 197,31138; 131,19898 - 19938; Adams - 107,13364 and 16350 - 51).

Since the applicants are unable to predict in advance or control the amount of snow or the date at which the tundra will be able to accept construction of a snow road, even with manufactured snow, the very real possibility exists of a poor experience with snow road use and a request for permission to construct gravel roads after the first construction season. Because that possibility does exist, C.A.R.C. views this issue as a concern of highest priority. C.A.R.C. submits that the applicant has not demonstrated that its construction schedule can be maintained using only snow roads under all the possible weather conditions and season variations that might be encountered, particularly on the Yukon north slope and in the Mackenzie Delta. Because permanent or semi-permanent roads are environmentally unacceptable in these areas questions of the construction and standards of construction of snow roads must be resolved in advance of approval of the pipeline project.

RECOMMENDATIONS

1. It be written as an unalterable term of any approval to build a pipeline that no permanent or semi-permanent roads or gravel pads or similar access are to be allowed in any circumstances along any portion of the pipeline route and, more specifically, along the north slope of the Yukon or the Mackenzie Delta.
2. Further research be conducted to demonstrate the viability of the use of snow roads on ice-rich soils and in all

circumstances likely to be encountered and not merely on the basis of average conditions.

3. The acceptability of snow manufacturing and snow gathering techniques suggested by the applicant be tested and examined under actual field conditions. In particular, research be directed to consider the environmental impact of snow fences and the withdrawal of water for snow manufacturing.

(c) CONSTRUCTION SCHEDULING

Concern has been expressed, both from environmental interveners and residents of the north, that the proposed construction schedule is unrealistic and will lead to environmental impacts that remain unidentified and unevaluated. The winter construction schedule, particularly on the north slope of the Yukon, is tied to the availability of snow and the length of time an acceptable snow road can be maintained. Concern has been expressed as to the ability of a snow road to be maintained throughout the construction schedule proposed, the environmental effects of abandonment of the snow road in the spring, personnel problems with winter construction, productivity estimates, work "slippage" and many other potential problems with a tight construction schedule. (Templeton - 67,9863 - 71; Adam - 72,10805 - 7; Rutter - 77,11438 - 9; Templeton - 58, 8160; Lent - 105,16141 - 59; Mirosh - 67,9897 - 98; 68,10139 and 10158, Dau - 37,4764 - 79; Williams 86,12992 - 13,000).

Except for engineering proposals to help extend the life of the snow road during the spring season, the applicants have not provided contingency plans or alternatives they propose to follow in the event that the snow road does not last throughout the period required by their construction work schedule. Right to the end of the Inquiry the question as to whether or not the proposed construction schedule is realistic, particularly on the north slope and, we would submit, in the Mackenzie Delta, has been a contentious issue (195,30586 - 30618).

RECOMMENDATIONS

1. The applicant, particularly when considering construction on the north slope of the Yukon and in the Mackenzie Delta, has not demonstrated that its construction work schedule is practical in all climatic conditions that may be encountered during the construction season. Therefore, a more conservative construction schedule must be required of the applicant, particularly in the early years of construction,

to ensure that construction will take place only during those times of the year when environmental damage can be kept within acceptable limits.

2. A contingency plan must be prepared which provides for alternative construction timing in the event of slippage or if climatic or other environmental conditions demand an unanticipated reduction in the winter construction season.

(d) RIVER CROSSINGS

Of particular concern in the design and construction of the proposed pipeline is the question of river crossings. Because any failure or threat to the integrity of the gas pipeline requires immediate attention and repair, and because vital water bodies cannot be tampered with during particular times of the year, either because of rapid runoff or because of particular sensitivity due to fish migration, the environmental concern over river crossings is particularly acute. The problems of slumping, avalanching and solifluction along disturbed banks during warmer weather, river icings and scour, sedimentation and siltation, disposal of dredged materials and maintenance of sub-surface drainage all add to this concern. Should deeper burial be required this will result in more costly construction procedures at river crossings with greater environmental degradation because of the need to dispose of larger amounts of material and the probability that longer river crossing construction time will be required.

In the view of the Canadian Arctic Resources Committee the possibility of using overhead crossings has not been adequately examined. In view of the fact that a greater shut-off pressure may be required than originally estimated with, hence, anticipated greater costs in river crossings, the economic viability of overhead crossings should be re-examined.

RECOMMENDATIONS

1. That the possibility of overhead river crossings be re-examined, particularly for deep, narrow crossings or crossings with ice-rich banks.

(22,2666 and
24,2817 - 19;
Wilimovsky -
48,6407;
Parker -
54,7538)

2. All major river crossings should be licenced under the Northern Inland Waters Act and not merely authorized. This would mean that public notice and public hearings may be required before approval can be granted for construction of the major river crossings.

(MacLeod -
196,30835 - 7

(e) REVEGETATION

Because of the importance of the revegetation process on slope stability, terrain degradation and drainage and erosion control, the revegetation procedures must be demonstrated to be effective within the timeframe required for rehabilitation. The two pipeline applicants have submitted independent revegetation programmes and have each criticized the other's programme as unsuited to the requirements of revegetation. Neither applicant has shown that its revegetation programme will be successful in all of the areas where it will be employed, particularly in ice-rich permafrost and on slopes where erosion may be a problem. Both revegetation programmes are dependent on a stable soil surface with particular criteria to assist in propagation and on the ability to initiate seeding at a critical time of the year. Neither applicant, however, has evaluated its revegetation programme in all types of terrain to be encountered or if seeding cannot take place at the times and in the manner anticipated.

RECOMMENDATIONS

1. The applicants must conduct further field testing to demonstrate the acceptability of the respective revegetation programme particularly on slopes and in areas of ice-rich permafrost.
2. The applicants shall demonstrate that the revegetation programme or some alternative programme designed to prevent erosion and other adverse environmental impacts, is possible in areas of sensitivity in the event that revegetation cannot take place at the optimum time and in the manner proposed.

B. ENVIRONMENT

The pace and scope of development in the Canadian Arctic is taking place at such an accelerated rate that it is outstripping our knowledge of the environment and the wildlife of the area. So little environmental evidence is available on such matters as wildlife dynamics and over such a relatively short period of time that it is almost impossible to make a prediction of environmental impact of the pipeline in a number of critical areas.

The environmental submissions and recommendations of the Canadian Arctic Resources Committee are spelled out in detail

in the sections dealing with the particular environmental concern. Almost every section contains a series of recommendations for further study and research. Citing just two examples, evidence was led that another two or three years would be required just to provide an inventory of the fish resource and yet fisheries was perhaps the most studied environmental concern. The section dealing with the important concern over caribou contains a long list of knowledge gaps.

Another problem has been that the research was often misdirected, given the real needs of the northern communities. For example, the whitefish is one of the most important species for subsistence and commercial use, yet was one of the least studied. Although the Mackenzie Delta area is one of the most important beluga calving areas, no direct disturbance studies were conducted and even the precise location of the calving area is still unknown. Although there is no clear cut evidence that methanol released to the environment a little at a time will be intolerable to aquatic organisms, there is similarly no evidence that incrementally it is environmentally acceptable. Again, such research is vital before one can make any conclusions with respect to environmental impact.

The Canadian Arctic Resources Committee has attempted to identify a number of environmental areas requiring further study and indicate the knowledge gaps that exist. C.A.R.C. submits that until these knowledge gaps have been satisfied, no comprehensive understanding of the potential environmental impact of the proposed gas pipeline is possible and any consideration of major development projects should proceed with extreme caution. Our predictions of impact can only be as good as our data, and in too many instances our data base is inadequate. One of the ways to improve the data base is to give permanent protection to certain areas that will be long-term outdoor laboratories and that is why C.A.R.C. urges, in another part of this submission, that several proposed IBP sites be set aside before any pipeline right-of-way is approved.

For many geotechnical and environmental questions, the theme of the applicants at this Inquiry has been to leave the details to be worked out during final design. We also note that many of the environmental management goals, for example, those mentioned in the 1972 Pipeline Guidelines with abundant use of terms such as "minimize impact" or "acceptable standards", still remain vague. The Canadian Arctic Resources Committee stresses that leaving important questions to final design and leaving many environmental management steps as vague goals to "minimize" impact can only mean pipeline construction would, in

effect, be a large experimental undertaking.

The uncertainties of proposed geotechnical approaches, many gaps in our knowledge of the northern environment, and the local, national, and international importance of northern habitats are all reasons why we should proceed with caution and should not be guilty of experimenting on the north.

LOOPING

Evidence at the Inquiry indicated the distinct possibility that the proposed Mackenzie Valley gas pipeline would be looped and that this looping may even commence soon after completion of the initial construction. (Horte - 45,5912-25, 42,5563-65 and 50,6669-77; Blair - 58,8160-83) This would extend the construction activity in the Mackenzie Valley area beyond the period suggested in the current applications and, added to the possibility of an oil pipeline, could result in construction activity for as long as 15 to 20 years. (52,6909-10)

Looping will undoubtedly encounter many of the same problems studied with respect to construction of the pipeline, with the added significant environmental feature that it will be constructed in an area already heavily impacted by the first pipeline and may, if current plans for an oil pipeline are followed, be constructed at the same time as an oil pipeline.

The effect of this sequence of construction is unknown; even as it affects the plans for the current gas pipeline. For example, witnesses for Arctic Gas suggested that roads designated as temporary may be left in place if they would be required for subsequent looping. (Williams and Hemstock - 81,12007)

Such basic environmental questions as to whether or not looping is best undertaken immediately upon completion of the main construction while the various supporting infrastructures are in place or whether one should wait a period of time, and how long one should wait before re-attending, also remain largely unanswered. (Templeton 108,16555; Hemstock - 81,12010; Craik - 108,16552).

The environmental impact of looping was not studied by the applicants and there is not sufficient evidence before the Inquiry to allow it to make any recommendations about the probable impact of looping the gas pipeline. The Inquiry should make a clear statement that it cannot evaluate a looped gas pipeline on the basis of evidence before it and that further studies, many of a very different nature, would be required before a proper environmental impact assessment could be made. (Dau - 18,2037-38; Purcell - 30,3786; Wilimovsky - 47,6156; Templeton - 48,6449; Banfield - 52,6883-5; and 53,7097-8; Mirosh - 63,9024)

RECOMMENDATIONS

1. Any application for a looping of the pipeline shall be treated as a completely new and separate pipeline proposal and be subject to a further inquiry, including new research on the environmental and social economic impact, further public hearings and consultation and re-evaluation once the impact of the already constructed pipeline has been understood.

(Banfield -
52,6883-5;
96,14467; Gunn
-90,13669;
Hemstock -
97,14772;
McTaggart-Cowa
- 108,16441 an
16537-9)

ROUTING: GENERAL

It is undeniable that there are adverse environmental impacts of a gas pipeline that cannot be avoided or mitigated. No matter how skilfully the pipeline is constructed, it is still necessary to bring men and machinery into an area and to provide infrastructure that will alter the environment. If a critical area is to be protected, the only way of completely avoiding environmental damage is by routing the pipeline away from the area. For that reason, the question of route selection is one of the most fundamental and important issues before the Inquiry.

There are currently four separate pipeline routes before regulatory agencies to move Alaska natural gas to southern markets (the two Arctic Gas routes, the Alaskan Highway route and the all-American El Paso proposal). Evidence at this Inquiry has also suggested an examination be made of a route south of the Porcupine River (the Calef route). In the Mackenzie Delta and Mackenzie River area there are the two Arctic Gas alternatives (the Circum-Delta and Cross-Delta alternatives.) In addition, Edge-of-the-Shield, and East of Franklins routes have been proposed as alternatives to a Mackenzie River Valley route. Finally, there are minor variations between the Arctic Gas and Foothills routes in the Mackenzie River Valley. There are, therefore, alternatives to be considered. The optimum route must also be evaluated as a potential route for an oil pipeline and highway because, whether or not a deliberate corridor policy is adopted, it is likely that any subsequent oil pipeline or highway would follow the route established for the gas pipeline. In other words, the first major pipeline project will create a de facto corridor.

The applicants have made their cases on an assumption that a Mackenzie Valley routing is the best choice possible. In the case of Arctic Gas the evidence shows that the prime factor taken into consideration was the shortest distance between Prudhoe Bay and mid-continent markets that would pick up Mackenzie Delta gas along the way. (Dau - 15,1648-52 and 1665-76; 16,1760-78) The choice having been made, the efforts of the applicants have been directed to proving ex post facto that their proposed route is the preferred one. But this conclusion cannot logically be drawn without an examination of the alternatives. This examination has not taken place. Only now is the Alaska Highway routing for Prudhoe Bay gas being considered, but studies on social, environmental and economic impacts are not being done in as much detail as in the Mackenzie Valley. Similarly, there have not been studies that would compare with Mackenzie Valley studies for a pipeline

southwards around Hudson Bay from the Arctic Islands.

RECOMMENDATIONS

1. Alternative routing options should be properly examined both for Prudhoe Bay natural gas and Mackenzie Delta natural gas, including the possibility that a pipeline route from the Canadian High Arctic might be combined with a Mackenzie Delta pipeline as the preferred system for serving Canadian markets and needs.
2. Evaluation of alternative pipeline routes must be carried out within the context of possible corridor developments such as an oil pipeline and highway.
3. Until the alternative pipeline routes have been properly evaluated, no proposed route should be approved for the grant of right-of-way.

ARCTIC INTERNATIONAL WILDLIFE RANGE

The strongest support for establishment of the Arctic International Wildlife Range comes from the Arctic Gas pipeline proponents. The mere fact that Arctic Gas recognizes the route around the Alaska portion of the Range as an alternative (an area that has a formal range established) yet goes through the same ecological unit in Canada (an area that is not yet an established wildlife range) indicates that a range must be established to avoid incursion by industrial projects. (49, 6538-42).

Evidence by Bliss (46, 6144-45; 108, 16559), Lent (106, 16181-82, 16255), Collins (53, 7281-82), Leonard (53A, 7311), and Weedon (54, 7480) has stressed the biological uniqueness of the proposed Arctic International Wildlife Range. The suggestion by Arctic Gas witness, Dr. Banfield, that the area is not a unique one has been forcefully refuted, we submit, by the evidence of Dr. Lent and Dr. Weedon who commented directly on the uniqueness of the area. In addition, the earlier evidence of Mr. Leonard, Mr. Collins and Dr. Thompson concerning the Range presents overwhelming evidence on the uniqueness of the area. In addition, the subsequent evidence of Dr. Calef, Dr. Bergerud and Dr. Lent concerning the Porcupine caribou herd, its uniqueness and the importance of the Range area to its survival, served further to emphasize the uniqueness of this area.

In addition to its uniqueness, the Range is the only area with a possibility of official sanction and protection as a wilderness area. The existence of the Arctic National Wildlife Range in Alaska provides a legal and psychological basis from which further protective measures are possible. It is currently the only tundra area in the United States with protected status and the only area with any reasonable possibility of wilderness designation by the U.S. Congress. (The inclusion of the area as wilderness under the U.S. "Wilderness Act" would give strong protection to the calving area of the Porcupine caribou herd and the summer caribou habitat.) The potential for protection of the caribou herd exists because an area which has been declared a wilderness in the United States is exempt from any industrial activity. If a pipeline were to go through the Wildlife Range prior to its official designation as a wilderness area it could no longer qualify under American legislation as a wilderness. Once this happened, the area would be open to a variety of threats including subsequent oil pipelines, permanent roads, test drilling and other related activities. Therefore, even if we were to assume a gas pipeline would have little effect on the caribou or other flora and fauna of the area, the mere approval of a gas pipeline would take the area out of a wilderness status and jeopardize the survival of the area due to subsequent developments. As a first major project designed to cut across the Range in both the United States and Canada the legal effect of its approval would have far-reaching consequences. The potentially litigious issue, at least in the United States of America, regarding the invasion of the Range, must be kept in mind and the potential consequences on the Canadian side, in legal terms, cannot be over estimated. (Leonard - 53A, 7304-05; Lent - 106, 16182; Calef - 106, 16225).

Environmental associations in both Canada and the United States such as the Arctic International Wildlife Range Society, The Canadian-United States Environmental Council, The Sierra Club and the Wilderness Society have all

ARCTIC INTERNATIONAL WILDLIFE RANGE

officially taken the position that no pipeline should violate the range area. (Leonard - 53A, 7297; 53A, 7341). The evidence of witnesses before this Inquiry in support of the Range have made it clear that the creation of an energy corridor through the Range is completely incompatible with the objectives of the Range and regard the pipeline crossing of the Range as a major and adverse impact on the area. The panel, made up of the international members of the Range Society, clearly indicated their preference that there be no pipeline through the Range while admitting that if a pipeline must be built, they preferred one route as compared to the other.

It was emphatically stated that a hot oil pipeline is completely incompatible with the whole concept of the Range and is completely unacceptable. Similarly the concept of a permanent road through the Range is intolerable. (Leonard - 53A, 7335-36; Bliss - 108, 16559; Weedon - 54, 7467).

The intrusion of a pipeline upon an untouched area is irreversible and tragic, whatever steps are taken to mitigate its effects. The encouragement to other industrial development, particularly that related to petroleum development, is bound to follow. As a matter of logic and economic sense, proximity to a pipeline is an encouragement to further develop and explore the area. The location of a gas pipeline, therefore, will encourage further exploration and development in the Range, forever destroying its wilderness value and any possibility of it being a protected area. At the same time, the designation of a pipeline route is potentially the first step in creation of an energy corridor. Canada must develop a policy similar to that of the State of Alaska, as expressed before this Inquiry, that living resources must be given priority over oil and gas development in those unique areas where the habitat of those living resources is identified as critical. Canada has an obligation internationally to preserve its unique areas and to ensure the survival of its living resources where other alternatives are available. (76, 11281-82).

If there is ever to be a wilderness or a park in Canada that includes the Yukon's unique, unglaciated ecosystem, it must be found somewhere between the west shore of the Mackenzie and the Alaska border. (CARC Panel 99, 15081). The longer Canada procrastinates in setting up its Canadian portion of the Range, the more difficult it becomes for Alaskan officials to continue on with a sound programme of conservation and to acquire the necessary funding from the American Congress for improved programmes. (Collins - 53, 7282-83). Special status must be given to the Range area in Canada similar to that provided for the Range in Alaska so that, along with the Americans, there can be created one of the great national protective regions in the world. (Thompson - 53, 7272; Bergerud - 110, 16770-71). The international boundary is a happenstance in the middle of a total biological unit, especially for the caribou, wolves and other migratory animals, demanding international co-operation. (Leonard - 53A, 7296).

In terms of preserving an area of coastal tundra there is only one opportunity in the United States of America and that is within the Arctic Wildlife Range of Alaska. It is also the only one with the caribou calving in large aggregations. Because of the international boundary, it also has international

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values so that the establishment of an international area would be of mutual benefit to the people of Canada and the United States. (Lent - 106, 162550).

The intangible values associated with the proposed Arctic International Wildlife Range must be weighed against the cost saving as a principal reason for selection of routes across the Range. Industrialization of the proposed Range would overwhelm the wilderness character and ultimately and irrevocably destroy its unique naturalness. It would also have a profound effect on international responsibilities in the management of the Porcupine caribou herd. (Thompson - 53A, 7307). It was agreed that no further steps in the legal sense should be taken with respect to those lands proposed for the Canadian portion of the Wildlife Range pending the disposition of the Native Land Claims. When seeking to establish priority within the area of Native Claims, the first priority would be assigned to the use of the Old Crow Band and the Coastal Inuit. Outside of those areas the wildlife value should be given primary concern. (Thompson - 53A, 7307-08; Thompson - 53, 7277).

Uses which society as a whole makes of the proposed Range will be determined by the management authority under such restrictions and regulations as are necessary to the wildlife population and to safeguard the traditional life of the native people. Native people will have a tremendous role to play in the management and conservation of the Range area. (Thompson - 53A, 7308; Collins - 53, 7282-83).

IMPLICATIONS FOR ROUTE SELECTION

It appears that economic and engineering concerns ranked ahead of considerations of the environment in the selection of the Arctic Gas Prime Route which runs through the Range along the coast. Certainly, Arctic Gas did not give the same consideration for the wilderness values of Canada as they apparently are prepared to do in the United States. Arctic Gas was willing to divert its route around the Arctic Wildlife Range in Alaska as an alternative to its prime route, yet was not prepared to provide the same consideration for the proposed Range in Canada. The fact that this is so indicates that unless there is a legal obstacle, such as the creation and establishment of an international range, development will proceed through the area.

The International Wildlife Range panel and the Alaska witnesses indicated clearly that any routing which diverts pipelines away from the Range area is to be preferred. (Thompson - 53A, 7306, 7308, 7342). These same witnesses went on to say that if a pipeline were ordered to be constructed through the proposed Arctic International Wildlife Range, the coastal route would be preferred; despite this preference they held a strong conviction that there should be no pipeline across the north slope of the Yukon.

The concern about the Prime Route from the Alaskan perspective was summarized by Mr. Weedon who stated,

In summary, the impact of the proposed prime route is considered to be severe and adverse since it commits land uses in the absence of a comprehensive statement or regional plan in Alaska. This is

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especially important since the proposed pipeline invades the only remaining large area on the Alaskan Arctic coast where human activities are not already pronounced or where land use commitments have not already been made which will increase activity. It should be possible if no pipeline system is built across the Arctic National Wildlife Range to establish an ecological reserve system for the Arctic that will provide areas for future studies and serve as an ecological base from which to monitor changes brought about by future development elsewhere in Alaska.

Construction, operation and maintenance of the proposed natural gas pipeline and subsequent industrial development in the Arctic National Wildlife Range would greatly reduce the value of that area for inclusion in a research natural area system, since much of the development would substantially modify existing natural conditions.
(Weedon - 54, 7469)

The witnesses called on behalf of the Arctic International Wildlife Range unanimously recommended that consideration be given to routing along the Fairbanks Corridor which has the great advantage of being mostly within a utility and highway corridor already heavily impacted by man and being away from the Range area. The value of the Fairbanks Corridor is especially significant if one is to consider the possible routing of a hot oil pipeline and the resulting permanent road that would be required. The fact the Fairbanks Corridor is an existing transportation corridor where the land commitment has been made is one of the primary factors in the State of Alaska taking the position that the prime Arctic Gas route not be allowed to pass through the Wildlife Range. (Parker - 75, 11076; 75, 11128-29; Lent - 106, 16183; Leonard - 53A, 7336-37 and 7298). It is significant that geotechnical experts for Arctic Gas have stated that the more southerly U.S. corridor, involving a route through the southern Yukon, is technically feasible. (Vol. 17, 1886-87).

RECOMMENDATIONS

1. That the Canadian Government create and declare the Canadian portion of the Arctic International Wildlife Range as proposed by the Arctic International Wildlife Range Society.
2. That the creation of an International Wildlife Range take place prior to the construction of any major facility within the area of the proposed Range and in conjunction with settlement of native land claims.
3. That the Canadian authorities work in co-operation and in conjunction with the American authorities to have the proposed Range receive the highest form of protection under their respective laws. Canada should provide whatever assurances are required to have the American portion declared a "wilderness area" and arrange for a similar declaration of the Canadian portion.

ARCTIC INTERNATIONAL WILDLIFE RANGE

4. That the area within the proposed Range be protected and excluded from any pipelines or pipeline related activity and, in particular, that the range area be protected from the development of an energy corridor which might include a road and an oil pipeline. Given the current alternatives considered by Arctic Gas, this would mean a pipeline constructed along the Alaska Highway since both the Prime and Interior routes proposed by Arctic Gas would traverse the proposed Range in Canada.

INTERNATIONAL BIOLOGICAL PROGRAM (IBP) SITES

The main purpose of the International Biological Program was to study biological productivity of the earth's surface in relation to human welfare. This research soon made it very clear that outdoor laboratories in which measurements of productivity are to be made require some sort of assurance that the outdoor laboratory is still going to be there to allow remeasurement in five, ten or twenty years as the need may arise. For this reason one section of the International Biological Program was called Conservation of Terrestrial Communities and was abbreviated "CT" and it devoted its efforts to an inventory of areas suitable for preservation as long-term outdoor laboratories. Seven formal applications were prepared for ecological sites in the NWT and Yukon in the summer of 1975. These were submitted to the Minister of Indian Affairs and Northern Development on 16 September 1975. (Peterson - 101, 15433-15437).

Proposed ecological reserves can range from small single use areas for outright preservation of some biological or ecological feature to large multiple use areas that could be zoned and managed to allow protection of biological features concurrent with industrial development in adjacent zones. Included in the seven formal applications for ecological reserves that have now been filed by the IBP panels are some sites that would be specifically designed to monitor the side effects of industrial development. (Peterson - 101, 15438-15439).

In the comments that introduced these final arguments by the Canadian Arctic Resources Committee, it was asked where several years of study and public hearings have brought us. Whether or not a pipeline is approved, the hearing procedures that have taken place have repeatedly involved speculation about biological impact of the proposed development. Much of the biological information brought out at this Inquiry has been re-cycled from short duration studies at a few locations in the north. There are no outdoor laboratories from which we can draw reliable, long-term biological records to improve our predictive capabilities - and there are no outdoor laboratories (monitoring areas) that tell us what has actually happened in the post-construction phases of other projects such as hydro developments or road construction.

If a pipeline is approved for the Mackenzie Valley or northern Yukon, it is imperative that a grant of right-of-way be preceded by a designation of lands that would perform the dual functions envisaged for IBP sites - namely the preservation of both representative and unique habitats and the establishment of areas that will be the permanent outdoor laboratories for future scientific studies.

It is important to stress that the scientists who have proposed IBP sites in the north regard native people as part of the ecosystem. This will be compatible with the legal establishment of ecological sites. In some cases, however, it will be necessary to develop management restrictions in consultation with native people to ensure that the animal resources within ecological sites are not over-harvested. In relation to Native Land Claims, co-chairmen of the two northern IBP panels have taken the position that

INTERNATIONAL BIOLOGICAL PROGRAM (IBP) SITES

regardless of who owns or controls the land, there are certain areas that deserve special protection and management. By protecting certain life systems characteristic of the Yukon and NWT, the proposed IBP sites would not only be preserving some areas for long-term study and education but would also be protecting the hunting and fishing resources of the native people. (Peterson - 101, 15442).

Established ecological sites would require management plans and in some cases zoning. Most reserves would have some part that is zoned and managed for maximum preservation and other parts that would be meant for scientific study in a variety of monitoring measurements of disturbances. That is why it is not necessarily a contradiction to have things such as pipelines passing through some parts of some reserves.

RECOMMENDATIONS

1. If a gas pipeline right-of-way is granted there should be an advance reservation of those proposed IBP sites near the projected pipeline route which have already been submitted in application form to the minister of Indian Affairs and Northern Development. This would involve three proposed IBP sites: Dolomite Lake - Campbell Lake site; Willow Lake (Brackett Lake) site; and Caribou Hills site.
2. It is recommended that the Dolomite Lake - Campbell Lake site be set aside under provisions of the Canada Wildlife Act.
3. It is recommended that for the Willow Lake (Brackett Lake) site the portion of most importance to waterfowl be designated as a bird sanctuary and the remainder be administered as a long-term monitoring area under the Territorial Lands Act and the Territorial Land Use Regulations.
4. It is recommended that the Caribou Hills site be set aside under the Territorial Lands Act and that it be zoned to include both multiple-use monitoring areas and some areas intended for single-use preservation.
5. Other proposed IBP sites that could be near to proposed pipeline routes, depending upon route alternatives that are still unsettled, should be given interim reservation before there is a grant of any pipeline right-of-way. These interim reservations for the Canadian Arctic Gas routes would include the following proposed sites: Old Crow Basin; Firth River; Rat River; South Mackenzie Delta; Ebbutt Hills, Canoe Lake, Garry and Pelly Islands, Toker Point; and Herschel Island. Relative to a route through the southern Yukon, proposed IBP sites that should be given advance reservation include: Sheep Mountain - Mount Wallace;

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Mt. Archibald - Decoeli area; Koidern River area; Klutlan Glacier area; Wolf Lake; Duke Meadow; and Coal River Springs. Relative to feeder lines proposed by Foothills Pipeline, additional IBP sites that should be given advance reservation include: Deep Bay Wood Bison Sanctuary; Mink and Fawn Lakes area; Mills Lake; and Heart Lake.

6. It is recommended that the following proposed IBP sites be evaluated by Canadian Wildlife Service officials as potential National Wildlife Areas: Wolf Lake; Klutlan Glacier area, and Firth River. The following proposed IBP sites should be evaluated as potential bird sanctuaries: Mills Lake; Mink and Fawn Lakes area; Koidern River area, and Toker Point.

CORRIDOR

The Northern Pipeline Guidelines have placed the issue of corridor development squarely before this Inquiry. In the evidence this issue has been seen in two distinct contexts. One is whether a corridor concept should be recommended to the government whereby a transportation corridor would be identified which would serve not only the proposed natural gas pipeline but also an oil pipeline, a highway and other possible developments such as a railway or high voltage transmission line. The other is whether the establishment of a natural gas pipeline route creates a de facto corridor with a high likelihood that an oil pipeline and other developments will follow so that an assessment of the impacts of a particular route for a natural gas pipeline should also include an assessment of the suitability of the route for an oil pipeline and other developments.

As to the first, C.A.R.C. does not recommend an explicit corridor policy. Rather, subsequent developments must be examined on their particular merits for the purpose of choosing the appropriate routing. (Parker - 76,11283-98) The studies we commissioned led us to the conclusion that we could not establish empirically that environmental effects would be lessened by combining transportation facilities in any single corridor. We also agree with the testimony of Dr. Banfield that the cumulative effect could be "synergistic and multiplicative rather than simply additive in total." (Banfield - 51,6876-78)

As to the second, the evidence establishes that the route chosen for a natural gas pipeline is likely to be followed by a subsequent oil pipeline, and possibly by other transportation facilities. Therefore the natural gas pipeline route creates de facto corridor and its environmental impacts must be evaluated on this basis. (McTaggart-Cowan - 47,6267; Horte - 50,6698-99; Leonard - 53A,7335-38; Fekete - C-23,2319-23). You, Mr. Commissioner, have on several occasions during the Inquiry made it clear to the applicants that they must provide evidence as to the environmental impacts of an oil pipeline along the route proposed for the natural gas pipeline. (Berger 42,5445-51; 52,6908-11; 83,12518-22; 90,13637-49) This they have not done. The witnesses for Arctic Gas admitted, in effect, that they had studied the impacts of a gas pipeline completely in isolation. (95,14437-51)

The result is that at the conclusion of this Inquiry the applicants have not shown what the total environmental impacts of building a natural gas pipeline will be because they have not presented evidence on the suitability of

their proposed routes for an oil pipeline and other facilities that in all likelihood will be established. Therefore, you, Mr. Commissioner, cannot report to the minister that either of the applicants has made a case for the issue of rights-of-way over Crown lands.

This is not merely a technical objection.

Numerous witnesses have stressed that the construction of an oil pipeline would create impacts of a significantly greater magnitude than those of a gas pipeline, both for the ecosystem as a whole as well as specific elements such as fish or vegetation. (Dabbs - 90,13615; McCart - 90,13760; Wilimovsky - 47,6168) Despite the urgings of the Inquiry, the potential impact of a combination of an oil and gas pipeline has not been conducted (90,13637-49). Although it may be possible to make some predictions from the results of the gas pipeline studies, a great deal more study would be necessary and many options now regarded as acceptable would be intolerable given the introduction of an oil pipeline. (McTaggart-Cowan - 47,6174)

To protect the integrity of an oil pipeline it would have to be constructed in its own right-of-way, the time and mode of construction would be different from a gas pipeline and it would require its own infrastructure of communication systems, maintenance staff and maintenance regime. It is entirely possible that the cumulative impact would exceed the adaptive tolerance of the environment and species living in the area of the combined disturbance. (51,6876-78)

Given that routing of a gas pipeline is regarded as being more flexible than that of an oil line (Dau - 16,1823), these concerns would apply even more urgently to the consideration of a corridor on the Yukon north slope. Many witnesses have testified as to the problems of a gas pipeline on the north slope; a further and more urgent concern is that if a gas pipeline were allowed along the Yukon north slope, it would be followed by an oil line. The Alaskan experience suggests that construction of a hot oil pipeline would require a permanent road for maintenance, a gravel pad for construction, a summer security patrol and very rapid repair requirements likely requiring stockpiles of pipe and equipment and increased activity during the critical spring and summer periods.

An elevated oil pipeline would threaten the migration patterns of the Porcupine caribou herd. The creation of the transportation corridor itself would stimulate other oil and gas development and create access from the Mackenzie Delta across the north slope to Alaska through a previously undisturbed area. The combined effect of any or all of the potential activities of a transportation corridor would, in the view of C.A.R.C., result in the environmental destruction of the Yukon north slope and, as such, is totally unacceptable. (McTaggart-Cowan - 107,16297-98; Templeton - 107,16309-11; Weedon - 54,7468; Thompson - 53A,7307; Leonard - 53A,7335-36)

C.A.R.C. also submits that an oil pipeline constitutes an extreme threat to the Mackenzie Delta and to the Mackenzie River itself. There has not been a thorough assessment of the impact of a major oil spill in the Mackenzie Delta despite the fact that such a spill would be of regional, national and global significance and must be regarded as a likely eventuality given the amount of the oil-related activity in the area. (Templeton - 109,16603-04) As for the Mackenzie River itself, building a lengthy pipeline almost entirely within one valley watershed places the entire river system in jeopardy.

An oil spill in the Arctic waters would have far-reaching environmental and socio-economic impact. Beaver and muskrat populations would be particularly vulnerable. It has been suggested that they may even be eliminated in areas that have a dense covering of oil. The introduction of an oil spill into the Mackenzie Delta, Old Crow Flats, Ramparts River or the other muskrat areas would be a major disaster. (McTaggart-Cowan - 47,6219; 108,16533). The impact of an oil spill on polar bears, seals and whales is largely unknown. Furthermore, the techniques and mitigative measures for dealing with oil spills are still in their infancy. Some witnesses have recommended that dispersants not be used to clean up oil spills, (McCart - 92,14013; Banfield - 92,14014; Gunn - 98,14888) and the use of chalk for cleanup of rivers is also not recommended. (McCart - 92,14019-20) In general, however, the techniques for mechanical cleanup of oil spills are still very poor and there is only a limited ability to remove oil from still or semi-still waters. (Wilimovsky - 108,16458)

In summary, it is the proposed route across the north slope of the Yukon that presents the gravest aspect of the oil pipeline issue. On few subjects has there been such unanimity in opposition to the construction of an oil pipeline across the Yukon north slope. If there is the shadow of a concern that approving a gas pipeline route across the north slope will encourage the later approval of an oil pipeline, then the approval of the gas pipeline should be withheld.

RECOMMENDATIONS

1. Because an oil pipeline would involve different geotechnical and environmental questions than have been considered for proposed gas pipelines, it is recommended that this Inquiry advise the Government of Canada that a complete and separate inquiry, preceded by appropriate environmental and socio-economic studies, is required before consideration can be given to an oil pipeline in the Canadian North, bearing in mind that the considerations given to a gas pipeline by this Inquiry have limited application to the issue of an oil pipeline.
2. An explicit transportation corridor concept should not be recommended, but each new transportation facility should be examined on its particular merits for the purpose of choosing the appropriate routing.
3. The choice of routing for a natural gas pipeline must be regarded as a designation of a de facto corridor with a high likelihood that an oil pipeline and other transportation facilities will subsequently be approved to follow the same general routing. Therefore, the assessment of the environmental impact of the proposed natural gas pipeline will not be complete without an assessment of the impacts of an oil pipeline along the same route. Such an assessment not having been made, the granting of a right-of-way should not be recommended at this time.
4. In no event should a right-of-way for a natural gas pipeline be authorized for the north slope of the Yukon because the granting of such a right-of-way may encourage the subsequent granting of (Weedon-54,7486; Templeton - 107,16309-11; Thompson -53a, 7307; Leonard - 53a,7335-36)

approval of an oil pipeline along the same route and such an oil pipeline presents unacceptable environmental hazards.

5. Further consideration should be given to the proposed Fairbanks Route as a corridor for both a gas and oil pipeline.

THE NORTHERN YUKON

The Yukon Territory north of the Porcupine River is a particularly significant part of Canada. The reasons the area has been proposed for the Arctic International Wildlife Range and various IBP sites are outlined in detail in the specific recommendations under those subject headings. But whatever the man-made designations, this area is regarded as a unique and highly significant area for a host of environmental reasons.

First, the area is the traditional home of the people of Old Crow and undoubtedly other participants before this Inquiry will stress the significance of this fact. From an environmental perspective, the area is a fragile yet uniquely beautiful part of our world. (Collins, 53,7279-83) It is extraordinarily rich throughout the open water season. It contains caribou migration routes in spring and again in autumn. It is a moulting ground for many hundreds of whistling swans and thousands of Canada geese and white-fronted geese. Many kinds of ducks, loons and a number of shore birds (some extremely rare) find their nesting grounds around the Arctic Coast. The whistling swans that nest along this coast constitute between 1/3 and 1/2 of the whole eastern flyway population of whistling swans in the world. There are some very fascinating and extremely valuable spits and offshore islands that are important because they provide protection for the nesting birds (McTaggart-Cowan - 47,6178-80). Over one hundred bird species have been identified on the Yukon north slope alone. (Gunn - 97,14833)

With respect to terrestrial mammals, moose and beaver are distributed very widely throughout the entire area; grizzly bear, wolverines, marten, wolf, and dall sheep are predominant. (McTaggart-Cowan - 47,6198-99)

Concerns about constructing a gas pipeline along the north coast of the Yukon have centered around a wide range of environmental, geotechnical and engineering concerns. The potential for construction difficulties on the north coast is related to bad weather, a tight construction schedule, and problems of access for repair, (Dau - 37,4737; Hurd - 40,5249-51; 42,5451-2); ice-rich soil encountered on the north slope (Zoltai - 101,15469); rapid changes in river channel patterns (Cooper - 25,3040); the unproven success of snow road construction (107,16350-51); and the limited availability of water. (Walker - 103,15748-9).

The greatest concern for the northern Yukon relates to the potential that any pipeline route approved now will become a part of a transportation corridor. Whether because the snow road construction does not prove adequate, and permanent road access is required or whether as a matter of policy an oil pipeline is to follow the gas pipeline routing, the result would, in the almost unanimous view of all, be the destruction of essential wildlife habitat in the northern Yukon. (Templeton - 107,16309-11)

Concern over protection of the fish resource has also centered on Yukon Territory north of the Porcupine River. Although the fisheries of the northern Yukon have been one of the most intensely studied subjects, evidence was led that further research of from one to three years would be required to completely understand the fish population of the northern Yukon (Steigenberger - 104,15919), and great concern was expressed as to the potential adverse impact on fish. (Walker - 104,15968-90)

Identification of particular concerns and recommendations pertaining to the northern Yukon are identified elsewhere in this submission in the sections dealing with the fur-bearers, waterfowl, rare and endangered species, and fish.

THE PORCUPINE CARIBOU HERD AND THE NORTHERN YUKON

Undoubtedly, a major concern about the northern Yukon centers around the Porcupine Caribou Herd. Caribou experts talked about scientific aspects such as the migration patterns and life cycles of the caribou herds, whereas native people described caribou as part of the fabric of their lives and culture. What both scientists and natives did share, however, was concern about the ability of the caribou, especially the Porcupine Herd, to withstand the pressures of proposed industrial developments.

The Porcupine Caribou Herd, which numbers approximately 100,000 animals, is one of the four largest herds in North America. This herd represents one of the last herding herbivores (other than sheep) remaining in North America, and one of the greatest wildlife spectacles left to man. The oldest direct evidence of man in the New World is a scraper made from a caribou thigh bone found in the Old Crow Flats and carbon-dated as thirty thousand years old. It attests to the archaeological significance of the

herd and the historical dependence of the Indian people on these caribou as a resource. Although migration routes vary somewhat from year to year, Indian-made caribou fences and old hunting camps indicate that caribou migration has followed a basic traditional pattern throughout the centuries.

There have been marked declines of other caribou herds in other parts of North America. These occurrences have been attributed to the onset of roads, power projects, railways, and other developments added to natural cycles and events. In Alaska today, the Forty-Mile Herd is the vestige of a herd which was at one time the largest west of the Mackenzie River and larger than any existing in North America today. Yet its "disappearance" is in some ways inexplicable to scientists. The range of arguments presented to this Inquiry to explain the mystery are academic. In light of the history of the Forty-Mile Herd and the development planned across the northern Yukon the fate of the Porcupine Caribou Herd falls under an ominous shadow.

The Porcupine Caribou Herd calves in the coastal plain and Foothills area of the northern Yukon and Alaska. Biologists appearing before the Inquiry agree that this calving period is the most critical and sensitive time in the caribou life cycle and, along with the period of post-calving aggregation, is the time when particular care must be taken to protect the herd. In recognition of the threat to the caribou herd, Arctic Gas has presented a series of mitigative measures; they have unequivocally promised that no road would be built along the north slope (Dau - 52,6886-7); they have promised to monitor caribou migration movements, to fill or fence trenches, restrict aircraft flights, and to shut down construction if caribou arrive on the calving ground in close proximity to the pipeline (although the work schedule initially proposed does not provide for any shutdown days due to the presence of caribou); they have promised to forbid pipeline personnel from possessing firearms, to leave breaks in the pipe or to temporarily turn strung pipe to allow the passage of animals, to fence compressor station sites and air strips, and generally to adopt a construction schedule that will provide for a shutdown of operations by the time the major caribou concentrations traditionally occupy any given area. Concern has been expressed with respect to all of these undertakings and the recommendations relating to these concerns are outlined in detail in the section dealing with caribou.

This Inquiry has heard numerous concerns relating to caribou along the proposed coastal route north of the British Mountains. These are covered later in this submission in the more detailed recommendations dealing with caribou. Some of the main concerns with respect to the coastal route are:

- (a) The uncertain effect of snow fences on the herd (107,16352; Jakimchuk - 96,14675-78)
- (b) That the route traverses the calving area that is crucial to the herd and is one of the most restricted areas used by caribou. The calving period of the caribou is the most sensitive and critical time for the herd. The impacts of any disturbance during this period create great stress to the herd.
- (c) There will be compressor stations with turbine engines within the calving grounds. Their construction will take place in summer during the calving period and the noise will create constant disturbance.
- (d) The post-calving aggregation occurs on the coast where there will be some summer activity. During this aggregation the entire population of caribou assembles in dense concentrations into one group. This event takes place in an even more restricted and more consistent area from year to year than does calving.
- (e) Some caribou do not go south to winter but remain on the coast for that purpose. (Lent - 105,16139-41)
- (f) The coastal area is significant to caribou not only for calving but as an area where the impact of the mosquitoes and other pests is minimized for at least a few weeks. (Lent - 105,16141)
- (g) The summer period when caribou are on the coast is a more stressful time for the animals since they are bothered by mosquitoes, warble flies and botflies, and their energy demands for antler growth, moulting, and nursing are at a maximum for the year. (McTaggart-Cowan - 108,16425)

- (h) There is evidence to show that the greatest amount of calf mortality occurs during the short summer period on the coast. Harassment by aircraft or other activities can cause stampedes which result in separation of calves from their mothers. Such calves are susceptible to wind chill mortality and predation.
- (i) Migrating animals would be in the vicinity of the pipeline on the coastal route for as much as two months.
- (j) The erosion and flooding problems in later spring along the coastal route would necessitate surveillance flights and repair operations, increasing contacts with caribou.
- (k) Fog is more frequent along the coast and will cause helicopters to fly at a low level which would harass the caribou during calving.
- (l) Calving grounds may be key real estate in the adaptive race between escape and predation in the wolf-caribou interaction. At calving time, caribou are more vulnerable to predation than at any other time.
- (m) In the likely event of an elevated oil pipeline, large groups of the magnitude found along the coast are less likely to travel over or under a barrier.
- (n) There is a hypothesis that the caribou are attracted to the coastal area because of the vegetation there. (Lent - 105,16141 and 110, 16834-35)

It is because of these concerns and because of the fact that a great number of people, both laymen and biologists, are not satisfied that these concerns can be met that grave doubts have been expressed about any form of construction in the northern Yukon. Fear has been expressed for the safety and even survival of most of the major species encountered on the northern Yukon and, in particular, the Porcupine caribou Herd.

The Canadian Arctic Resources Committee wishes to stress that argument between the Coastal route and the Interior

route in the northern Yukon does not come to grips with the real issue. Dr. Gunn, in his evidence on behalf of Arctic Gas, stated that the Interior Route is to be preferred to the Coastal Route (93,14167); and in his evidence Mr. Jakimchuk, on behalf of Arctic Gas, stated that the Coastal Route is to be preferred to the Interior Route. Even if one looks at the major species of concern, the caribou, there is conflicting expert evidence. The biologists consulting to Arctic Gas stated that the Coastal Route was preferred, while other biologists (Dr. McTaggart-Cowan, Dr. Calef, Dr. Bergerud, Dr. Lent and Dr. Giest) have all stated concern over the survival of the Porcupine Caribou Herd if the Coastal Route is used.

The only conclusion to be drawn is that there is no pipeline route in the Yukon north of the Porcupine River that can be constructed in an environmentally acceptable manner. Given the fact that the gas pipeline might be followed by an elevated hot oil pipeline and an access road, the overwhelming evidence is that there should be no pipeline construction in the Yukon north of the Porcupine River.

RECOMMENDATIONS

1. No pipeline route should be approved in the northern Yukon north of the Porcupine River or across the Mackenzie Delta.
2. The northern Yukon north of the Porcupine River should be given protective status to ensure that no future applications for pipelines, gathering facilities, or other similar developments will be entertained.
3. The 1972 Pipeline Guidelines should be amended by the Government of Canada to make it clear that the government will not accept applications for pipelines across the northern Yukon north of the Porcupine River or across the Mackenzie Delta.

CROSS-DELTA ROUTE ALTERNATIVE

The proposed pipeline route of the applicant, Canadian Arctic Gas, was amended to include a lateral across the Mackenzie Delta. While arguing that it is a more secure system in the sense that it has less miles of pipe, Arctic Gas agreed that the route would save approximately one hundred million dollars and that it was proposed because of its economic attractiveness. (Dau - 15,1869 and 2082-83) It was also conceded that the original Circum-Delta route was selected because it was deemed that the Mackenzie Delta was a particularly sensitive area. Evidence presented at the delta phase of the Inquiry suggests that, indeed, the Mackenzie Delta is a unique and sensitive environment and it is C.A.R.C.'s view that the economic savings to the applicant must be viewed as subordinate to the preservation and protection of the Mackenzie Delta.

The amount and nature of research conducted in the Mackenzie Delta region, particularly in the Shallow Bay area, is inadequate for a complete geotechnical or environmental assessment (Volume 19-A). Problems of ice jams (20,2508), ice scour (20,2509), the nature and frost susceptibility of soil along the Shallow Bay crossing (22,2639), frost heave (22,2640-42) are largely unresolved as they relate to the Delta. Perhaps the best indication of our poor state of knowledge for this route alternative is the fact that the Environment Protection Board, when it initially gave evidence before the Inquiry, refused to comment on the Cross-Delta alternative because of the lack of available data (46,6094; 48,6439).

It must be remembered that the Mackenzie Delta region is subject to the cumulative effects of not only pipeline construction, but the area is also a staging and supply area, is affected by Beaufort Sea drilling and other hydrocarbon exploration, and will be the centre of the gas-gathering and processing facilities. Add to this the possibility that the pipeline may be looped and these cumulative impacts could result in a lengthy period of activity within the critical areas of the Mackenzie Delta region (43,5561-79).

There are also significant environmental reasons for opposing the Cross-Delta route across Shallow Bay. Shallow Bay is literally teeming with fish for five months from July to November, and the Shallow Bay crossing will require summer dredging. Although CAGPL has stated it will shut down operations during the time that the

beluga whales come into the Delta to calve, concern has been expressed that such disruption and noise could cause depletions in the new-born populations. Fuel spill or oil spill containment would be much more difficult if the Cross-Delta route is built. Since efforts to de-oil birds have proven unsuccessful in other areas, there is a great threat to the populations of snowgeese and other waterfowl which use this area during critical periods of their life cycle. Also, any pipeline activity along the Yukon Coastal route may result in waterfowl, particularly snowgeese, moving to the vicinity of the Cross-Delta route, thus compounding the environmental impact. (Gunn - 93,14175-75)

The potential environmental impact of the Cross-Delta route alternative is not completely known but on the basis of the evidence to date it is the submission of C.A.R.C. that a pipeline should not be constructed across the Mackenzie Delta.

RECOMMENDATIONS

1. The proposed Cross-Delta alternative should be rejected because of the need to preserve the whale, waterfowl and habitats of the Mackenzie Delta which will already be heavily impacted by pipeline-related and other hydro-carbon exploration activity.
2. Immediate steps should be taken to have the outer Mackenzie Delta area set aside as a whale sanctuary, to secure the protection of the reindeer population of the Delta, and to ensure that the existing sanctuary for waterfowl is preserved and protected. (122,18494;
89,13419;
47,6186)

LAND USE PLANNING

Many witnesses have expressed the need for long range land-use planning in the Canadian north.*

A proper land-use plan must first determine the biological productivity of an area and the requirements necessary to maintain and ensure the continuance of that productivity. It must not only permit that society to determine whether and where certain developments must be undertaken, but must also permit that society determine the pace of development both for the benefit of the biological community and the society itself. (Gourdeau - 108,16561) Such a plan must deal with the conflicting claims on the land for such purposes as native hunting, fishing and trapping, national and territorial parks, wildlife refuges, ecological reserves, energy and transportation corridors, and mining and hydro-electric developments. (Bliss - 48,6343-53)

The elements of the land-use plan can only be developed through northern-based research because research results from the south cannot be simply translated into the north. Even in the south it has taken 75 years to learn how to restock salmon, and a similar lead time can be assumed to be necessary to properly understand the northern fishery resource. Many of the environmental witnesses emphasized the need for an overall programme for protection of the fish resource as the only real way to ensure environmental protection. (McCart - 91,13936; Stein - 103,15742-43) The same imperative applies towards protection of the caribou, waterfowl and various other species. Unless such an overall plan is prepared well in advance of any major development, critical habitat could be usurped by the development project with the result that any programme would become prohibitively expensive, if possible at all.

The land-use plan must be dynamic because there will be a continuing need to modify the plan as new knowledge becomes available and as new uses are defined. Therefore, the planning process is as important as the plan itself.

One important element in the development of a land-use plan is identification of special areas. Areas of particular significance in the Canadian western Arctic have been identified by C.A.R.C. in the sections under the Arctic International Wildlife Range, I.B.P. sites and in the various sections dealing with specific species where critical or essential habitats have been isolated. Having identified these critical areas, whether critical habitat, areas for rare and endangered species, potential recreation or park sites, archaeological sites or areas of unique or scenic value, the next step is to build them into the land-use plan.

* McTaggart-Cowan 47,6192-3; Craik 48,6318; Templeton 48,6345-6 and 108,16555-58, 119,16663-4; Hemstock 82,11213-34; Banfield 95,14499; McCart 91,13936; Weedon 54,7462-7; Bliss 48,6343-53; Gourdeau 108,16561; Parker 54,7518-28; Owen 70,10445-48; Roed 78,11498; Stein 103,15742-3

The wilderness concept is also an important element of such planning. The need to protect wilderness areas and the wilderness values must perhaps be spoken to in emotional terms as well as ecological terms. As environmentalists, and as Canadians, we have a responsibility to ensure that there are some areas of our nation that remain as wilderness. Not only is this important to ensure that there remains an unspoiled ecological unit to preserve and protect a way of life that has developed over thousands of years, but it is important as a concept within the Canadian heritage. Canadians have viewed their country as evolving out of a vast wilderness, yet we are fast approaching the last chance for authentic wilderness areas.

Most discussions relating to the protection of a wilderness invariably centre around the Yukon north of the Porcupine River. Because of the proposed Wildlife Range, the unique ecological components of the area and the fact that the area is largely undisturbed, it becomes a prime candidate for designation as a wilderness area. (99,15073-4)

Both applicants have agreed that present wilderness areas (meaning untouched, unspoiled or untrod upon areas) should be protected and disturbance of these areas should be minimized (Arctic Gas - Hemstock, 82,12212-3; and Foothills - Bouckhout, 88,13201). The applicants should be required to provide more specific information on the impact of their project created merely by increased access. The challenge is to ensure that the frontier and wilderness heritage is not lost sight of in the examination of detailed environmental impact.

In many respects, this Inquiry can be regarded as the initiation of a planning process for the Mackenzie River Valley and the Delta although it is starting from the wrong point. Ideally, planning should start with a clean slate, whereas this Inquiry is forced to begin from the restricted viewpoint of where to build a gas pipeline.

In fact, the route selection for a gas pipeline, with its implications as a de facto transportation corridor, is of fundamental importance for the planning of the region. Just as selecting the pipeline route destroys freedoms and options for a land claim settlement, so does it also take away land-use options. Ideally, the selection of a route for the gas pipeline should proceed only after a long-range plan has been developed and in accordance with that plan.

RECOMMENDATIONS

1. Any further consideration of the routing of a pipeline, or of any other major transportation facility, should be postponed until appropriate land-use planning procedures have been established for the Yukon and Northwest Territories and long-range land-use plans have evolved.
2. A complete inventory identifying special areas should be undertaken before approval of any pipeline route.
3. Once critical areas have been identified, appropriate legislation designed to ensure their continued protection, whether as parks, sanctuaries, ecological reserves or natural landmarks, should be enacted before any pipeline approval is given.
4. All that area north of the Porcupine River in the northern Yukon should be declared a Wilderness Area and appropriate legislation should be passed by the Government of Canada to provide for and declare a wilderness status for this area.
5. One of the responsibilities of the pipeline authority would be to control the use or further construction of access roads following construction of the pipeline. This task should be undertaken by the Government of Canada since the question of access and opening up of specified areas should be a matter of public policy and not an issue to be left to the pipeline companies. (Arctic Gas 82,12,185 and 12,204-5, EPB 107, 16336039)
6. Access into an area and development of the recreational potential of the area should be postponed a few years after completion of construction. This would decrease the cumulative impact on the environment and would allow new administrative techniques, advisory and supervisory techniques to be employed and a larger research base to ensure a more integrated and effective control over impact. (EPB 47, 6270-71)

IMPLEMENTATION

In stating its recommendations with respect to implementation, C.A.R.C. in no way endorses or supports the proposals of the pipeline proponents. These recommendations are made on three hypothetical assumptions:

- (1) That it has been decided that a pipeline is in the public interest and that authority has been given for it to proceed;
- (2) That requirements for environmental protection have been identified and defined in considerable detail in a set of stipulations for the construction of the pipeline and of its related facilities.
- (3) That the native people own a substantial part of the lands which will be subject to the pipeline right-of-way (Thompson, Vol. 196, p. 30850).

Effective implementation of environmental stipulations will be attained only if requirements are viewed from the beginning as an integral part of the construction scheduling and operations rather than something imposed from outside. Therefore it is not sufficient to write these stipulations into the terms of right-of-way agreements, certificates of public convenience and necessity, land use permits, water licences or regulations such as the Territorial Land Use Regulations or the Gas Pipeline Regulations. Government responsibility does not end with the prescribing of environmental dos and don'ts since contractors must not be permitted to independently determine the degree to which they and their sub-contractors will ensure full compliance and the extent to which operating crews will be trained and mandated to carry out environmental protection procedures. (Thompson, Vol. 196, 30851)

The existing administrative machinery in the territories is both inadequate and inappropriate to properly supervise construction of the proposed pipeline and ensure compliance with environmental stipulations. Too many different federal and territorial government departments and agencies share responsibility for some 87 pipeline-related activities through at least 44 different pieces of legislation for there to be any hope that the present system could function effectively to regulate pipeline construction. (Craik, Vol. 48, p. 6316-17)

Therefore the powers shared by this diverse group of departments and agencies must be delegated to a single authority for purposes of supervising construction of the pipeline. Among the various federal agencies having mandate in the north there are none which could effectively fulfil the role of single authority. (Skinnarland's Study, p.16). None of the existing agencies and departments has the organization or experience that would be necessary to properly fulfil this role and each is handicapped by its lack of experience and knowledge in areas outside its own mandate. (Skinnarland, Vol. 196, p.30783-90, Thompson, Vo. 1976, p.30852) The two best qualified departments (N.E.B. and D.I.A.N.D.) each suffer from fatal weaknesses. The Department of Indian Affairs and Northern Development must be disqualified because of inherent conflicts. On the one hand, it has a mandate to develop the north and has encouraged development by issuing oil and gas exploration permits in many areas while on the other hand it has a social responsibility to the natives and their culture which includes the environment. (Craik, Vo. 48, p.6316-17). Although the National Energy Board has authority and expertise to deal with pipeline engineering, safety and efficiency, it has only residual authority to deal with environmental and social problems resulting from pipeline construction and no experience with the special environmental and social problems resulting from the geography of the proposed pipeline. (Thompson, Vo. 196, p.30859)

It is therefore recommended that responsibility for all relevant regulatory functions be assigned to a totally independent single authority and that the pipeline-related powers of all federal and territorial departments and agencies be delegated to it. This authority should be assisted by a third party contractor who would assist in the design review process and follow-up. Such system would result in the most efficient implementation possible of all the environmental stipulations identified by this Inquiry, the National Energy Board and other contributing agencies. (Thompson, Vol. 1976, p.30858)

Because of the terrific cost of this project and the tremendous expense of any delay once construction has started, all environmental stipulations must be clearly set out in the design criteria well in advance of the start of construction and then strictly adhered to (Skinnarland, Vol. 196, p.30878). Rather than burden government agency personnel who have a host of other activities to regulate and who would argue that the execution of their day to day responsibilities should not be sacrificed to the requirements of one particular project, a third party contractor should be engaged to carry out the design review for the independent authority and ensure that environmental stipulations are sufficiently entrenched in the pipeline design (Thompson, Vol. 196, p.30854).

Finally, we emphasize that the establishment of a single, all-encompassing pipeline authority will not contribute to the slow and difficult process of evolving viable social and political

institutions in the north. The most that can be said for our recommendations is that they may result in efficient management of the pipeline so far as it is possible to minimize environmental impacts and they are designed to contribute the least harm to the development of regional social and political institutions. (Thompson, V. 196, p. 30868)

RECOMMENDATIONS

1. An independent authority should be given full jurisdiction over the entire construction process on and off the pipeline right-of-way to ensure compliance with all environmental stipulations. (Thompson, Vol. 196, p. 30862-7)
2. The organization structure of this authority should be as shown in the diagram found in Appendix "A". (Thompson, Vol. 196, p. 30862-7)
3. The authority should be structured to represent the three parties who will be most affected:
 - The federal government
 - The territorial government, and
 - The native communities.

The authority should comprise three individuals, one appointed by each of these parties. The authority should function as a land owner who hires a supervising engineer to oversee a construction project rather than as an inter-governmental committee with members required to maintain inter-department liaison and obtain directions from their ministers and cabinets. The landowners in this case are the federal government, the territorial government and the native communities and thus each appoints one member of the authority.

(Thompson,
Vol. 196,
p. 30862-7)

4. The authority, although composed of three members appointed by the federal government, territorial government, and native communities respectively should be completely independent from those three bodies. Its members should not operate as delegates of the bodies that appointed them and should not be under any requirement to report directly to them. (Thompson, Vol. 196, p. 30969)

5. The responsibilities of the authority should be limited to those matters which relate directly to the construction of the pipeline although they should not be limited to the right-of-way. To the extent that it is possible to do so without decreasing the effectiveness of the authority, its terms of reference should be limited so as not to totally dismember government in the north. (Thompson, Vol. 196, p. 30930)
6. One factor that should be considered in deciding which areas of authority should be delegated to the implementation authority is whether a particular matter requires great speed or a long lead time to execute. Another factor to be considered is whether the particular matter is of great local and regional concern, the less local and regional concern expressed the more likely that it should be delegated to the authority. (Thompson & MacLeod, Vol. 196, p. 30940)
7. The authority should appoint an authorized officer whose function in the model is equivalent to that of a supervising engineer and whose relationship to the authority would be akin to that of a chief executive officer to a board of directors. (Thompson, Vol. 196, p. 30862-7)
8. Such a single authority should obtain the necessary administrative support and scientific and technical expertise through the engagement of a third party contractor. (Skinnarland, Vol. 196, p. 30782)
9. There must be a design review process whereby the pipeline applicant is required to submit his pipeline design, his construction schedule, his material specifications and his contract documentation to the independent authority for review and approval, to ensure that all environmental stipulations have been integrated therein to provide a complete environmental code. This process will provide the most effective means of implementing environmental impact abatement procedures. (Skinnarland Vol. 196, p. 30782) (Thompson, Vol. 196, p. 30862-7)
10. Environmental criteria and stipulations should form an integral part of the project's design criteria. Thus provisions setting forth the environmental stipulations should be incorporated into all supply and construction contracts. (Skinnarland Vol. 196, p. 30782)

11. Supervising responsibilities of government departments that are directly related to construction of the pipeline should be delegated to the authority and authorized officer's field representatives should be empowered to carry out these responsibilities including the taking of security bonds, etc. These field representatives might be seconded from the federal and territorial civil service, e.g. resource management officers or inspectors under the Northern Inland Waters Act. (Thompson, Vol. 196 p. 30864)
12. The discharge by the National Energy Board staff of their supervisory functions over pipeline engineering, safety and efficiency should be coordinated with the staffwork of the third party contractor and the authorized officer by the establishment of linkages from the very top. One way this could be accomplished would be to have a member of the National Energy Board appointed as a non-voting member of the Implementation Authority. (Thompson, Vol. 196, p. 30866-7)
13. An ombudsman should be appointed who is answerable directly to the Parliament of Canada and fully empowered to obtain information and report to the public. His role would continue well beyond the construction period and after the authorized officer and the third party contractor have been discharged because some injuries and damages and claims will not come to the surface immediately. (Thompson, Vol. 196, p. 30866-7)
14. The ombudsman should be assisted by an advisory committee representing many different interests such as native organizations, environmental groups and government departments who would contribute advice to the ombudsman and disseminate information to the public. (Thompson, Vol. 196, p. 30867)
15. The costs of the Implementation Authority and the ombudsman should be paid for by a levy on the successful pipeline applicant who would in turn recover these payments by including them in the cost of service of a pipeline for rate-making purposes. (Thompson, Vol. 196, p. 30867)
16. One of the responsibilities of the authority should be to develop a plan for the continued monitoring of the pipeline from an environmental

point of view after construction is completed. The authority should recommend what further on-going type of supervision and responsibility would be most efficient and effective. Disaster prevention and disaster containment should be included in the design review.

(Thompson &
Skinnarland,
Vol. 196,
p. 30909)

CARIBOUA. GENERAL RECOMMENDATIONS REGARDING A GAS PIPELINE ACROSS THE NORTHERN YUKON

Caribou stand out among northern animals as the dominant species in the sub-arctic ecosystems, and in the lives of the native peoples who hunt and depend on them. The great herds provide one of the last wildlife spectacles on the earth, whose beauty and significance to man and to the ecosystems they inhabit cannot be measured. The northern native peoples--the original inhabitants of this continent--have testified before this hearing as to the vital importance of the caribou in their history, their culture, and their current well-being. The Porcupine herd of barren-ground caribou, whose ranges in Alaska, the Yukon and the Northwest Territories would be crossed by either of the proposed Canadian Arctic Gas (CAGSL) pipeline routes, is one of the largest in the world, deserving therefore of special protection.

The Canadian Arctic Gas pipeline project poses a variety of potential threats to the caribou including: blocking or delaying of migrations; disruption of normal calving activities; disturbance and harassment of animals at all times of year by construction activities, vehicles, and aircraft; direct mortality through collisions with vehicles; and increased hunting both by pipeline personnel, and others who gain access through pipeline facilities. These threats are recognized by many biologists including the applicant's own consultants. The only disagreements are about which routes and construction techniques would best reduce the effects of a pipeline on caribou. In view of the importance of the caribou herds, developments such as the proposed gas pipeline must proceed slowly and cautiously.

In considering the impact of a gas pipeline on caribou, and most other wildlife species as well, one must take into account the many related activities that are likely to follow. The gas pipeline route, as the first transportation system applied for, could unleash extensive subsequent activity and construction wherever it is built. The gas pipeline is expected to stimulate petroleum exploration, elevated oil pipelines, roads, gathering lines, processing plants, and increased human populations, which in concert would be more than the caribou and the wilderness of Alaska, the Yukon, and the Northwest Territories can withstand. Already there is alarm over the impact of the construction of the Dempster Highway.

The applicant's own consultants have testified that their opinions of the pipeline's acceptability were determined in isolation from other developments, and that cumulative impact of the pipeline with other developments could destroy the Porcupine caribou herd. For these reasons it seems prudent to avoid a transportation corridor across the wilderness of the northern Yukon, and rather to establish an International Wildlife Range to protect this area which is so vital to the caribou and the many other species of this biologically diverse area.

For the above reasons, the Canadian Arctic Resources Committee recommends that:

1. The Inquiry recommend against the construction of a gas pipeline from Prudhoe Bay by either the Coastal or the Interior routes which have been proposed by CAGSL.
2. The Inquiry recommend the establishment of the already proposed Arctic International Wildlife Range to provide a protected area where the preservation of wildlife habitat and wildlife species in general, and caribou in particular, is of paramount importance.
3. Since one of the most important features of caribou involves their movements and migrations and since an above-ground pipeline presents much more of a barrier to caribou than a below-ground gas line, the report of the Inquiry must state unequivocally that the proponent has not met the requirements of the pipeline guidelines to provide
 - (i) "assessment of the suitability of the applicant's route for nearby routing of the other pipeline in terms of the environmental-social and terrain engineering consequences of the other pipeline and the combined effect of the two pipelines, and (ii) assessment of the environmental-social impact of both pipelines on nearby settlements or nearby existing or proposed transportation systems."
4. The Inquiry should make it clear that if an oil pipeline is proposed in the vicinity of any caribou or reindeer population an entirely separate set of terms and conditions would be required because those which can be recommended by the Inquiry can

refer only to a buried gas pipeline. Further, the Inquiry should make clear that the existing data base would be quite inadequate for resolving issues that would arise in relation to construction and operation of a hot oil pipeline.

B. RECOMMENDATIONS ON CHOICE OF ROUTE

Virtually all of the witnesses who testified at this Inquiry have stated that the Fairbanks Corridor appears to pose much less of a threat to the caribou herds than do either of the routes proposed by CAGSL through the northern Yukon. This is because the Fairbanks Corridor would avoid most areas used by major caribou herds, and because much impact from construction of the Alyeska oil pipeline has occurred already. Therefore, the Canadian Arctic Resources Committee suggests that:

5. The Inquiry recommend that the Canadian government take immediate action in conjunction with the U.S. to examine the relative environmental and social merits of the Fairbanks Corridor alternative as a route for the transportation of Alaskan gas to states south of the 49th parallel.

As indicated by the recommendation above, the Canadian Arctic Resources Committee feels strongly that there should be no pipeline construction through any part of the northern Yukon north of the Porcupine River. Despite this position, it was necessary during the course of this Inquiry, to consider the relative merits of the two routes proposed through the northern Yukon by CAGSL. Much of the comparison of these two route alternatives focused on calving and post-calving areas because most biologists believe that disturbances during the calving and post-calving periods would be more harmful than disturbances at any other time of year. Areas used for calving and post-calving activities occur along the Coastal route but not along the Interior Route.

A much smaller area of habitat is available for calving and summering than is available for wintering and migrations. Also, animals driven from normal calving and summering areas would be more susceptible to insect parasitism and wolf predation. Harassment of caribou under stress could result in calves being separated from their mothers, thereby increasing their susceptibility to all forms of mortality. At calving time, caribou are more vulnerable to predation than at any other time of the year. During calving, the herd structure may have an anti-predator function and splintering of groups may increase the number of caribou

killed by wolves. The calving grounds may be the key in the balance that exists between wolves and caribou. Second best habitat may not be good enough. Therefore the calving grounds should be protected.

The Coastal route should be avoided because it is a calving area. It should also be avoided because calves disturbed by helicopters and other human activities during the nursing period, or calves which are separated from their dams, would be quite liable to wind chill mortality. The Interior route avoids these conflicts between the pipeline and the calving grounds and post-calving aggregations of caribou.

In addition to this primary consideration the witnesses called by CARC cited many secondary advantages to an Interior route, including:

- (i) Although the Interior route crosses some winter ranges, it avoids others that are often used. Along the Interior route most of the animals have passed the pipeline right-of-way by the peak flood times of the spring and by the beginning of the melting of the active layer. This is the period when pipeline surveillance would have to be most intensive because of the possibility of floods and erosion damage to the pipe. Therefore, one can expect more surveillance flights and the greater possibility of contact with caribou along the Coastal route since the increase of surveillance and maintenance activity and the presence of caribou coincide, unlike the Interior route. (Calef - 106,16224)
- (ii) Aircraft disturbance would not be as serious along the Interior route during construction and later in maintenance and repairs. Because of the continental nature of the weather as compared to the Coastal route, flights along the Interior route could normally remain above 1000 feet, thus minimizing harassment of the animals. (Bergerud - 110,16761)
- (iii) The compressor stations are to be constructed in the summer and clearly this would be more harmful along the Coastal route, where the caribou are present throughout the summer, than it would be along the Interior route. (Calef - 106,16227)

- (iv) Fog is common along the north slope and since helicopters in such cases will have to fly low across the calving grounds, the Interior route, which is less susceptible to fog, is superior. (Bergerud - 110,16755)
- (v) Along the Interior route the caribou would be in contact with pipeline activity only for two weeks whereas animals migrating along the coast would be in the vicinity of the pipeline on the Coastal route for as much as two months. (Calef - 106,16223). In addition the calving ground used by the Porcupine herd is approximately 4000 square miles as compared with 60,000 to 100,000 square miles which is used for wintering areas and for migration. (Calef - 106,16213)
- (vi) There is more snow cover along the Interior route than the Coastal route. Snow could be used to provide highways of compacted snow to lead the animals around or quickly through construction areas. If the migrating animals are "off course" their direction could be altered by snowmobile trails. The use of fences by native people to capture caribou indicates that drift fences will be effective in channelling caribou to crossings. (Bergerud - 110,16760)
- (vii) Possibly the second most important advantage of the Interior route is that it could be amended to have even a less detrimental effect on the Porcupine caribou herd. As recommended by Dr. Calef, the Interior route could, once it reaches Canada, continue south of the Porcupine River. This area south of the Porcupine River is used less by the native people from Old Crow than the area now proposed to be traversed by the Interior route and would also travel through the Eagle Plains and the Keele Mountains, two areas where there has been exploration. In these areas, therefore, there are large numbers of seismic lines, winter roads, and drill pads, some of which could be used in the construction of a gas pipeline, thus reducing the aesthetic damage and preventing more areas from being altered by man. (110,16846-47). A route south of the Porcupine River would also avoid a good part of the August dispersal thus minimizing its impact on the Porcupine herd. (Calef - 111,16956) Combined with the Interior route in Alaska, it would provide a route that goes around the proposed Arctic International Wildlife Range. This would enable

the Range to receive protective status in both Canada and the United States thus giving a legal basis to the protection of the calving and post-calving aggregation ranges for the Porcupine caribou herd. Any route that goes through the Range area weakens the legal protections that may be offered, especially in the United States, thus increasing the potential for future impact on the critical areas for the Porcupine herd. The importance of the north slope and the Arctic International Wildlife Range to caribou was emphasized by Dr. Lent. In Alaska it contains the only calving area for a major caribou herd that is in a protected zone. (Lent - 106,16181-82)

As a result of this evidence, the Canadian Arctic Resources Committee recommends that:

6. If the Inquiry must make a recommendation for either a Coastal or Interior route for the transportation of Alaska gas across Canada, then a recommendation should be made in favour of an Interior route that would avoid the Arctic International Wildlife Range and the environs of Old Crow and the Old Crow Flats by use of the Interior route proposed by Calef. (111,16956)

C. KNOWN INFORMATION GAPS IN PREDICTING IMPACT OF PIPELINE ON CARIBOU

The Canadian Arctic Resources Committee recommends that the Inquiry state explicitly that much information required for predicting the effect of a gas pipeline on caribou is currently not available. The information lacking includes especially the following:

- (i) Lack of demographic information such as population trends, birth rates, death rates, and sources of mortality;
- (ii) Lack of information on the effects of disturbances from aircraft, compressor stations, highway traffic, physical barriers, and particularly the long-term and cumulative effects of disturbances;

- (iii) Lack of knowledge of the status of the Bluenose caribou herd and its use of ranges on the east side of the Mackenzie Valley;
- (iv) Lack of knowledge of the status and ranges of the Woodland caribou in relation to lateral supply lines proposed to Yellowknife and Pine Point.

D. RECOMMENDATIONS FOR MONITORING CARIBOU DURING CONSTRUCTION AND OPERATION

If it is ordered that a pipeline be built through the northern Yukon, the Canadian Arctic Resources Committee recommends that the Inquiry:

7. Recommend that the applicant design and underwrite a monitoring programme to follow the movements of caribou during the construction period. This would allow construction crews and environmental monitors to be aware of the approach of migrating caribou and to shut down construction operations prior to the arrival of the caribou.
8. Recommend that the applicant undertake a programme of post-construction monitoring of the Porcupine caribou herd which includes at least:
 - (i) A census of the herd every second year by photographing the post-calving aggregations, carrying out composition counts, and correcting for under-represented sex and age classes;
 - (ii) Yearly determination of the pregnancy rate and birth rate of the herd;
 - (iii) Annual determination of the age structure of the herd by collecting lower jaws from hunter-killed animals;
 - (iv) Annual determination of the percentage of calves in the herd in October and March;
 - (v) Periodic assessment of the status of the wolf population and its predation rate on the caribou herds.

9. Recommend that the applicant state in writing what it will accept as a demonstration that pipeline activities have caused a decline in the caribou population. Processes should be established to evaluate claims of population declines and to provide for compensation and restorative measures for proven declines.

E. AIRCRAFT DISTURBANCE

10. Specific recommendations to avoid aircraft harassment and other disturbances based on limits established by research and set out in the Arctic Gas supporting documents as protective measures must be followed. Minimum altitudes of 2000 feet should be adhered to, and control over altitude, timing and flight pathways must be implemented and enforced. All flights should be straight level flights over any mammal concentrations. There should be no flights over caribou between May and October. (Jakimchuk - 89,13465; 94,14259-60; Jakimchuk - 89,13463-64; McTaggart-Cowan - 46,6216-17; Calef - 110,16810-11)
11. Caribou movements and distributions must be monitored each year to ensure that aerial seeding programmes do not begin until after the period of calving. (Dabbs - 82,12143)
12. There must be no aircraft overflights during the calving period and post-calving aggregation period. (Lent - 110, 98299)

F. AVOIDANCE OF COLLISIONS BETWEEN CARIBOU AND VEHICLES

13. Fencing of compressor station sites, airstrips and haul roads at strategic locations should be mandatory to avoid conflicts with caribou. (Jakimchuk - 89,13464)
14. Speed limits should be placed on vehicles to prevent collisions with caribou, especially on winter roads under stormy conditions or during ice-fog periods. (Jakimchuk - 94,15345-57; McTaggart-Cowan - 46,6220)

G. AVOIDANCE OF PHYSICAL BARRIERS AND DISTURBANCE

15. The process of the caribou migration must be continually monitored so that consultants can inform those at the area of construction activity in enough time to allow activities to be shut down to prevent disturbance to the herd. (Jakimchuk - 94,14313)
16. The monitoring and detailing of schedules for construction shut-downs should also apply to the less predictable activities of the caribou and to all related activities surrounding construction such as staging, camp preparation, and so on. The scope of this monitoring project and its details must be set out before the construction period begins. (94,14316; 99,15048-50)
17. Wherever construction activities and caribou migration are coincidental, all activities on the construction site must cease. (Dau - XXXIV, 4469)
18. No permanent roads, except those presently in existence, should be allowed along the pipeline right-of-way; attempts should be made to use existing highways, winter roads and seismic lines during pipeline construction. (A9,13478; 94,14337-38)
19. Every effort must be made to avoid placing of temporary access roads where they will cross migration routes. (McTaggart-Cowan - 46,6218)
20. All pipeline support traffic for the Interior route should be scheduled between 1 June and 1 September, the period when the caribou would most likely be in the summer range and completely away from the Dempster Highway and supporting roads. (Jakimchuk - 96,14611-12)
21. Experience in Alaska indicates that the combination of rows of heaped soil, an open ditch and welded pipe segments represent a total barrier to caribou migration. If long ditching is absolutely necessary, soft plugs and breaks in the pipe string at plug points should be required. (Lent - 106, 16169; McTaggart-Cowan 46,6205; Dau XXXIV, 4469)
22. All snow fences must be removed prior to spring migration of caribou. (Jakimchuk - 96,14678)

23. If any elevated pipe sections are to be authorized there should be a minimum clearance of ten feet; maps should be made of traditional migration routes and crossings constructed accordingly; advantage should be taken of natural terrain features and crossing facilities should be perpendicular to normal migration; design should be such to minimize snow drifting and colours should avoid visual contrast.
- (Lent - 105, 16150-51;
Lent - 106, 16176)

H. CONTROL OF ACCESS

24. The major protection for the Porcupine caribou herd has been inaccessibility which can be destroyed by the pipeline construction. Development of service roads and associated increases in the number of people in the area must demand increased control of access and hunting. Access must be limited in any areas affecting the Porcupine herd because large caribou herds that have come into intimate contact with man have never survived in their original numbers.
- (McTaggart-Cowan - 46,6204-05; 47,6203)
25. Access roads built for the construction period must be closed off after construction requirements are met under the authority of government officials in order to prevent greater access by hunters and numbers of people with potential detrimental effect on caribou.
- (82,12204-05)
26. The three access roads proposed between the Dempster Highway and the Interior route should be restricted solely to pipeline vehicles and should not be open to public access to ensure the protection of the Porcupine caribou herd.
- (Jakimchuk - 96,14610)

I. CONTROL OF HUNTING BY PIPELINE PERSONNEL

27. Sections 13.3 to 13.8 inclusive in Volume II (Towards an Environmental Code) should be enforced to ensure that pipeline personnel do not harvest caribou.
- (Envir. Prot. Board, Vol. II, 8-9)

J. CONTROL OF BLASTING IN RELATION TO CARIBOU

28. Sections 24.1, 24.5(a) and 24.5(b) in Volume II, (Towards an Environmental Code) should be enforced to protect caribou from harassment during blasting. (Envir. Prot. Board, Vol. II, 16)

K. ENFORCEMENT OF ENVIRONMENTAL PROTECTION MEASURES FOR CARIBOU

29. Since Arctic Gas has agreed that it will be up to the environmental experts monitoring the project to determine whether the herd is of sufficient size to merit a construction shutdown, it is mandatory that the environmental inspector have the authority to order immediate shutdown of construction. (XXXVII, 4761)
30. Detailed scheduling must be arranged in such a way to prevent slippages in timing such as occurred in Alaska. Chances of mortality to caribou by slippage of the construction schedule on the calving grounds and in areas of post-calving aggregations are very high. Large migrations might take one week to pass a construction site yet Arctic Gas has not included allowances for such events in calculated non-productive days. A more realistic and flexible schedule must be prepared to ensure that construction activities do not interfere with caribou migrations and critical biological periods. (Calef - 106, 16201-05; Lent - 110,16899-900; Bergerud and Lent - 111,16937; XXXIV, 4469-70)
31. Proper enforcement will require a relatively large number of officials and these officials will require good mobility to enforce regulations governing hunting by snowmobiles or aircraft harassment; methods of ensuring a proper number of well-trained and mobile staff are to be developed and staff training programmes commenced well in advance of construction. (Lent - 111,16954-55)
32. The powers and duties of game and fish management officials should be clearly established to give them enforcement powers and advanced training in enforcement processes appropriate to large scale developments. Much advance preparation must be carried out to foresee (Lent - 111,16948-49)

the problems involved in regulation of both pipeline personnel and other northern residents.

33. The experience in Alaska has shown that field personnel with biological experience need the authority to stop environmental degradation on the spot. At the same time, all parties need stipulations that are clear and precise enough to minimize delays caused by indecision or personal biases of the surveillance personnel. Since authority rests not only with the pipeline companies but with the pipeline contractors and sub-contractors, there is often a confusion in the hierarchy as to accountability and these issues should be clearly resolved before construction commences.
- (Lent -
106,16170-71;
106,16167)

L. FURTHER STUDIES

34. During this Inquiry, the need for additional studies has been stressed for caribou more than for any other subject. The Canadian Arctic Resources Committee recommends that the following suggested studies be initiated before final design review of any proposed gas pipeline.

CARIBOUFURTHER STUDIES

1. Since there is disagreement between Dr. Calef's findings and those of Banfield and Jakimchuk, further caribou studies should be undertaken to assess the amount of time the herd spends close to the Interior route apart from the time when it calves on the coast. (52,7050-51)
2. Further caribou studies should include attempts to ascertain the size of a caribou herd which is necessary for its survival, and to understand whether this particular Porcupine caribou herd could withstand certain disturbances and still recover. (Geist - 54,7429-30)
3. Further investigation should be carried out into the disappearance of the 40-mile herd since this information could give insight into the type of disturbance that leads to such extinction or grave depletions of herds. (53A,7382)
4. If the Interior route is chosen, further studies and monitoring will be necessary in order to minimize the effect of intensive noise levels on caribou in some areas along the route during construction. The applicant is to identify noise sensitive wildlife in the vicinity of the pipeline and consider this problem in finalizing station noise criteria. (82,12200-03) (Beer - 63,9005)
5. Further studies should be carried out on the effect of disturbance on the yearling calves which are travelling with pregnant cows on the migration route, and studies should be undertaken of the period of dissociation of the yearling from the mother. (94,14250-52)
6. Since the gas pipeline cannot be considered in isolation in terms of its impact on the Porcupine caribou herd, information should be made available immediately concerning the studies that have been carried out related to the effects of the Dempster Highway. If sufficient studies have not been carried out, the total impact of the gas pipeline and the Dempster must be evaluated before recommendations are set up to protect the caribou herd. The report concerning the Dempster Highway, referred to by witness Banfield on Page 14333 through 14334 of volume 94, should be made public. (94,14319) (94,14337-38)

FURTHER STUDIESCARIBOU

7. In assessing impacts of construction on caribou it is first necessary to know which factors cause disturbance and the extent of the physiological upset caused by each factor. Too, the physiological effect of profound excitement on the development, growth, mortality, and reproductive performance of individuals with particular emphasis on the developing embryo must be examined. (95,14479-81)
8. The Yukon Territory Game Branch and the Canadian Wildlife Service should undertake a study of the interactions of migrating caribou with the Dempster Highway. (Jakimchuk - 96,14595; 96,14626)
9. If the Interior route is chosen, research should be done to identify the critical areas along the Dempster Highway in light of the degree of convoy and vehicle traffic which would be deployed along the route. (Jakimchuk - 96,14610)
10. Further studies on the interaction and impact of activities with the post-calving aggregation should be made with the orientation of discovering more about the location, extent, and timing of the aggregation so that data would be available for the formation of protective measures. (Jakimchuk - 96,14612-13)
11. Full scale research should be carried out to determine the history of the 40-mile herd, and Alaskan scientists should be canvassed as to the nature and extent of studies carried out there. (Veale, Banfi - 96,14682)
12. If the Foothills Pipeline Application is accepted, detailed studies of the impacts on the Woodland caribou as a result of the lateral system from Yellowknife to Pinepoint must be carried out before construction begins. (99,15131-32)
13. Studies should be carried out to assess the potential problems for the Reindeer herd in finding suitable range material if the gas plants proceed and the Bluenose caribou herd continues to grow. (100,15210-12)
14. The potential conflict which may occur with caribou of the Bluenose herd in their wintering range between Travaillant Lake and Fort Good Hope must be studied in depth if the Foothills pipeline is accepted. (100,15209)

FURTHER STUDIESCARIBOU

15. If Foothills pipeline is given a permit to commence construction, the Canadian Wildlife Service studies on the Bluenose herd should be made available both to the pipeline authority officials and to Foothills. (100,15209)
16. Since an oil pipeline is likely going to run along the same corridor as the gas pipeline, studies carried out in Alaska concerning the effects of the barrier of an above-ground oil pipeline should be considered. The total cumulative impact on the Porcupine caribou herd of the Dempster Highway and the oil and gas pipelines must be considered. (105,16148-49)
17. Population estimates of the various caribou herds should be taken using air photos of post-calving aggregations. (Calef-106, 16189)
(Bergerud - 75,11072-73)
18. Further information should be gathered about the patterns of movement and the distribution of the herd throughout the year and the seasonal use of ranges and their response to pipeline activity. As well, the demographic characteristics of the herd, that is, its reproductive rates, survival of calves and the mortality of all age groups should be established. (Calef - 106,16189-90; 75,11072-73)
19. Compressor stations emit visual stimuli, olfactory stimuli and perhaps even tactile stimuli in the form of vibrations of the ground. Men, aircraft and vehicles come and go. In this light, further studies should be carried out on the actual impact of compressors before decisions are made on final routing and not, as with the Arctic Gas simulation experiments, isolate one disturbance factor. (Calef - 106,16235)
20. Information on behavior of caribou when encountering a variety of man-made disturbances and obstacles is needed. Simulations consisting of a two-mile snow fence covered with burlap sacking were not adequate tests of the impact and the reaction of caribou to a 50-mile stretch of the pipeline. (Calef - 106,16235 E.P.B. Interim Report No. 3, p. 31)
21. Since it will be difficult to attribute decreases in the Porcupine herd directly to pipeline activity, a programme must be established to follow the population dynamics of the herd during and after the project to ensure that such detection takes place. (Calef - 106,16239)

FURTHER STUDIESCARIBOU

22. Further studies should be carried out to assess the extent of wolf predation on the Porcupine caribou herd and the extent the wolves follow the herd. This would lead to more knowledge as to the degree to which the caribou escape a proportion of the wolves by coming onto the north slope for their calving and other similar activities. (Calef - 110,16795; and 16803)

23. The alteration of caribou-wolf interactions by winter roads can limit caribou populations. Further investigation is necessary to discover the effects of development on wolf abundance and behavior. More baseline data should be established to evaluate predation post-development. Predation losses should be quantified as well as studies carried out to measure these phenomena. (Bergerud - 110,16767,6 and 111,169)

24. The applicant should submit and give in the form of a commitment the type of study which would be carried out to monitor the herd during and after construction. These studies would go beyond simple shutdown and monitoring, but would involve detailed demographic work. The studies would not eliminate the types of arguments concerning the effects of the gas pipeline on the herd, but would allow early detection of any changes in the herd that seem substantial and if it looked like a trend was developing, serious measures would have to be taken. (Calef - 110,16797 and 16805)

25. Greater co-ordination in the future should occur among biologists since they create the disturbance factor in studying and measuring caribou and impacts of development. Some efforts have been made to get a long-range co-operative effort between parties of the Alaskan and Canadian side, and these efforts, so far, have not been fruitful. These efforts should be increased and pursued further. (Lent - 110,16828)

26. Management agencies should have an important contribution in the design of studies that would be looking into the effects of harassment. (Calef - 110,16829)

27. Although some tests were carried out in Alaska to compare the relative merits of overpasses versus underpasses for migrating caribou and the approach to an elevated line in some forested cover, further pipeline crossing designs will have to be tested at the proposed migratory crossings. (Bergerud - 110,16760)

FURTHER STUDIESCARIBOU

28. Tests should be conducted to validate the following (Bergerud -
hypotheses: 110,16760-61)
1. That animals are most likely to first cross in spring than in fall migration (therefore pipeline constructed in the winter).
 2. A light coloured line, perhaps a camouflaged line, is preferred to dark colour.
 3. Lines should be built to avoid noise and motion.
 4. The propensity to cross is in part a reflection of how well the other side is viewed and how contrasting the line is against adjacent habitat. This latter affects how close the animals can approach the line so as to see the other side.
29. If those responsible for building the pipeline want (Bergerud -
to avoid blame for any decline in the Porcupine 16765-66)
caribou herd, they will have to continue their studies for many years and improve their knowledge of the demography of caribou and wolves.
30. Studies concerning the distribution and movement (Bergerud -
of the Porcupine herd should be continued. As 110,16769-70)
well, the following statistics need to be gathered each year.
1. Status of the herd. The post-calving aggregation must be counted each year and the composition determined. Corrections are needed for under-represented sex and age classes.
 2. The birth rate of the herd should be determined each year. This is best accomplished by wildlife officers being stationed in Arctic Village and Old Crow. These officers would accompany hunters and determine pregnancy percentages.
 3. The age structure must be determined annually. Native hunters could be paid to bring in the lower jawbones of harvested animals.
 4. The percentage of calves in the herd in October and March should be determined.
 5. The status of wolf population should be assessed.
31. Research would be required throughout the construction period and probably for at least five to (Calef -
ten years afterwards in order to monitor population 110,16868-69)
changes of the Porcupine herd.

FURTHER STUDIESCARIBOU

32. Further studies should be carried out on the effects of dust falling on the tundra from the road surfaces. In Alaska it was found that this dust, moved by wind, affected the rate of snow-melt and drew herbivores to the areas along the roads. (Lent - 111,16942)

33. Further studies should also be carried out into the problem of industrial development in the Delta. It has been found that oil pollution coming from the United Kingdom has affected the lichen used by the reindeer in Scandinavia. It is argued therefore that air pollutants, especially sulphur dioxide, could affect winter range, of not only the Porcupine herd, but also the Bluenose caribou herd. (Lent - 111,16942-43)

34. That full research be carried out on demographic and behavioural patterns of the Porcupine herd before any other development is considered. In this way, it will be possible to assess the impact of this development on the herd before further undertakings are considered. In present studies, the effects of the Dempster Highway will deserve great attention. (Calef - 111,16953-54)

35. If the pipeline company does not wish to be blamed for a subsequent decline in the caribou herd, it should continue research until the predictive data are available to assess how populations are responding to this increased access. Much more work must be carried out on the problem of the increase in access and the rate of predation by carnivores. (Bergerud - 16957-58)

36. Where caribou are concerned, the most important recommendation is to have an adequate monitoring programme during and following construction in order to be aware of the location of caribou concentrations and the progress of their migrations, to gain the data necessary to provide good regulations, to detect any change in the caribou population or in its reproductive success. (McTaggart-Cov - 46,6220)

37. A knowledge of caribou food habits and their ability to use successional vegetation on burned over-winter ranges is required to evaluate potential impact of fires caused by pipeline. (E.P.B. No. 3 p. 31)

38. Information on the behavior of caribou in relation to snow conditions is required to understand and predict use of different winter ranges, spring migration routes and to determine if caribou will (E.P.B. No. 3 p. 31-32)

FURTHER STUDIESCARIBOU

38. (continued)

shift from one place to the other after being disturbed. We also need to know how the physical condition of pregnant cows is affected by winter conditions to predict how disturbance or habitat alteration on winter ranges may affect reproduction.

39. A tagging study to determine fidelity of individuals to particular migration routes and to understand the mechanism of group leadership is also needed to predict how soon the caribou will return to areas deserted because of disturbance.

(E.P.B. No. 3,
p. 32)

REINDEER

The reindeer herd in the Mackenzie Delta area is harvested as a valuable economic resource by people from Tuktoyaktuk. Although very few behavioural studies have been conducted as to the effect of pipeline construction on reindeer, the potential of damage to the herd through interference with normal range and herding techniques, harassment, or the absorption of the herd by putting it into contact with large caribou herds are all real dangers to be faced when considering pipeline activities in or around existing or potential reindeer herd areas. (Weedon - 75,11067-68; Whitney - 100,15210-12).

Although the reindeer industry is at best a marginal one, it does have a value to the local culture and could have a potentially great value in local economies. It is a source of food for the persons who supervise the herd and there is a potential for improvement. (Lent - 111,16945-6; 100,15362).

In view of the existing problems of reindeer management and the combination of potential future activities in the Mackenzie Delta, the future for reindeer herding in that area is bleak unless specific protective measures are implemented to preserve and protect this potentially valuable resource. There is a reindeer herd of approximately 5000 to 6000 animals which winter between the Mackenzie and the Miner rivers. Current plans provide for a pipeline that will cross through part of the range of this reindeer herd. In addition there will be access roads, scrubbing plants and some production facilities as well as above-the-ground gas feeder lines in and about the area currently used by the reindeer herd. (111,16937-38).

Activity in the reindeer range in the Mackenzie Delta has the potential of destroying the domestic reindeer herd by having it absorbed by the large Bluenose caribou herd whose range is in the area adjacent to that of the reindeer range. Activity in the reindeer range may result in the deflection of the reindeer herd or of the Bluenose herd from their traditional overwintering grounds. Such absorption would result in the virtual elimination of the reindeer as an independent domestic herd and would make them vulnerable to increased attack by the wolves that traditionally follow large caribou herds. (Lent - 111,169439-40 and 16945-46; 100,15359-64)

If an all-weather road is to be constructed for purposes of the pipeline right-of-way or the ancillary activities there is potential for vast quantities of dust falling on the tundra as

a result of activity on the haul road. Such dust affects the rate of melt on the snow cover and therefore has an effect on the vegetation in the area surrounding the road network. In Alaska, as a solution to the problem of dust from roads, road surfaces have been oiled down. Although there has been no research done on the ecological effect of applying crude oil to road surfaces, it appears that the crude oil becomes emulsified and sprayed off the road onto adjacent vegetation by the movement of vehicles. Various carnivores, such as foxes and wolves have been noticeably matted with this emulsified oil in and around these areas. (Lent - 111,16942).

Anything that threatens lichens threatens the reindeer and the caribou populations because lichens are a major complement to their winter diet. The experience in Scandinavia indicates that depending on wind patterns, industrial air pollutants, particularly sulfur-dioxide, may travel great distances and have a significant effect on reindeer winter ranges. (Lent - 111,16776 and 16942-43). Although the petroleum industry has, to date, reported only trace amounts of sulfur in oil and gas from the Mackenzie Delta region, it has acknowledged that high sulphur hydrocarbons could be encountered in this region in the future. Just as an oil pipeline raises a whole new set of environmental problems that have not been discussed at this Inquiry, any future developments that would involve release of sulfur-dioxide to the atmosphere would also create a new set of environmental problems that have not yet been fully researched for the Mackenzie Delta region. Therefore, the broad subject of interactions between sulfur-dioxide, lichens and reindeer is one that must be stressed for future attention. It is a potential environmental problem for which specific environmental protection recommendations cannot yet be made.

RECOMMENDATIONS

1. Evidence from Scandinavia indicates that railways or highways are a persistent source of annual mortality for reindeer. Winter roads should be used with great care and no permanent roads should be permitted in the reindeer winter range so as to avoid the potential for collision between vehicles and reindeer. (Lent - 111,16941-42; Calef - 106,16199)
2. Based on the effects of development on reindeer in Scandinavia, in each case the interruption of the migratory movement resulted in a decline in reindeer population or disruption of their behaviour. Abandonment of the range gradually takes place as fewer animals will attempt to cross highways or (Calef - 106, 16199; Jakimchuk - 89,13484)

other lines bisecting their traditional range. Any proposed pipeline route and accompanying access route must assure that this does not happen in the Mackenzie Delta region.

3. Unless proper crossing facilities are constructed over pipeline facilities, both reindeer and reindeer herders will have difficulty in getting reindeer to the right portion of the range at the right time in order to keep the range rotation programme going. A result will be that the winter range areas in particular will become overgrazed. Any pipeline route must give recognition to the need of an extended winter range area. This is particularly so in the Mackenzie Delta area where there will be many related activities and the potential for an above-ground feeder gas system. (Lent - 111, 16941-42)
4. If a pipeline and production facilities are to be approved for the area used by reindeer, studies should be conducted on the long-term effects that dust deposits would have on vegetation, particularly lichens. (Lent - 111, 16942)

A study of the problem of dust on vegetation should also examine the techniques available to prevent this problem, including both short and long-term effects of the use of oil as a road-surfacing material.

AQUATIC FUR-BEARERS (MUSKRAT AND BEAVER)

Besides its obvious ecological importance, the muskrat takes on a special significance because of its importance to the native communities along the proposed pipeline route and, in particular, the communities of Old Crow and Aklavik. As with the caribou, the "rat" is of cultural importance and is an important part of the diet of the native people. (Community Hearing Aklavik - C-2 and 3; Community Hearing Old Crow - C14-16) The Mackenzie Delta in particular is an excellent habitat for muskrats and beavers (Elanik - C-1, 20) and although the beaver is an important fur-bearer as well, the muskrat is the most important fur-bearer in the Delta and Old Crow areas (McTaggart-Cowan - 108,16517).

There appears to be a relationship between increased activity by man in the Mackenzie Delta area (seismic operations) and the decline of muskrat hunting or trapping in and around the Aklavik area (C-1,20; C-2,122; C-3,172). This question is currently being studied under the Arctic Land Use Research programme.

Besides being a major source of food, muskrats are important because they are almost a guaranteed source of income. Muskrat populations are concentrated and therefore relatively easy to trap (McTaggart-Cowan - 108,16517-19; Novakowski - 102,15701-02). For these reasons, protection of the muskrat population demands special consideration beyond its importance as an important element in the ecological web of the northern wetlands.

Many of the same considerations and recommendations relative to the muskrat apply to the beaver. Although the beaver normally frequents river or stream habitats rather than ponds, and although the populations are unevenly distributed, beaver populations are significant from the Mackenzie Delta upstream to the 60th parallel. (Novakowski - 102,15622-23).

Also, beavers are the mainstay of the trapping industry of the Mackenzie Valley area and are important to the native economies of the villages in the Mackenzie Delta and Old Crow. (McTaggart-Cowan - 108,16517; Novakowski - 102,15622-23). Although beavers are able to pioneer new habitats it is possible for them to choose an unsuitable habitat and not to thrive. (Novakowski - 102,15622-23).

The imposition of a reasoned yet effective game management scheme must be effected in advance of the use of the area concerned. Pipeline companies have their own momentum and

are not responsive to seasonal variation in hunting and trapping. In preparing and developing a game management plan for muskrats one must keep in mind its significance as a source of food and income as well as its role as a major component in the ecological system. A game management plan based on economic measures (muskrat as a resource) may not always coincide with a resource scheme based on biological concerns. Therefore the game management scheme must take into account these two often conflicting purposes. (Novakowski - 102,15702-04).

The Canadian Arctic Resources Committee has stressed that environmental effects of oil spills have not been brought out in the pipeline-related studies or in the Inquiry evidence. For this reason, much more comprehensive protective measures for the beavers and the muskrats must be developed for any potential oil pipelines. For any fuel spills or oil spills associated with a gas pipeline there would be downstream hazards for beavers and muskrats. (Novakowski - 102,15623 and 15672). Particular and very strict controls over the use of oil must be imposed in areas where there are significant populations of beavers and muskrats. The potential for oil or fuel spill damage to muskrat is of particular concern along the proposed pipeline route through the Mackenzie Delta and near the Old Crow flats. (McTaggart-Cowan - 108,16533). The concern is centred around the fact that both beavers and muskrats would ingest oil, possibly toxic quantities, by trying to clean the oil away and off of themselves. (Novakowski - 102,15672). It is necessary, therefore, to exercise unusual precautions against oil or fuel spills. These should include surrounding all storage facilities with a wall of impervious material high enough to retain 125% of the storage capacity, strict prohibition and effective enforcement of the prohibition against the discharge of waste engine or fuel oil into streams, lakes or other bodies of water, prompt and effective clean-up of all fuel oil or other chemical spills and the preparation, and training to effectively implement contingency plans for rapid clean-up by skilled employees (McTaggart-Cowan - 47,6219-22).

RECOMMENDATIONS

1. Any proposed pipeline alignment must be routed to avoid the flats north of Old Crow and locations in the Mackenzie Delta where there is any present or historical high density muskrat trapping area. Identification of high density muskrat trapping areas can be made through reference to the Environment Protection Board atlas and consultation in the communities. (Williams - 34, 4497-98; Whitney 100, 15351-52; Novakowski - 102 15623)

2. Muskrats, although known to migrate at high density, are usually restricted to a particular locale. The muskrat locales are basically pond systems which are in some form of evolution from youth to senescence and any disruption hastens that process and leads to destruction of the muskrat habitat. For that reason, outright avoidance of present or historical high density areas must be practised. (Whitney - 100, 15351-52; Novakowski - 102,15623)
3. Changed drainage patterns can have a major impact on muskrats. To maintain the present drainage patterns on which muskrats are dependent, the habitats around lakes containing muskrats and the creeks leading into these lakes must be maintained. (Whitney - 100, 15351-52; C-3, 172)
4. Sewage should not be discharged into swamps or land inhabited by muskrats. (Lawrence - 88,13249-51)
5. Blasting should be prohibited from an area within 50 feet of a lake or a pond area containing significant populations of muskrats. Blasting destroys muskrat habitat and in some cases kills the muskrat outright and also interferes with trapping operations. (Elanik - C-1, 24-28)
6. Following implementation of the various protective measures, close monitoring of the effects on beaver and muskrat habitats must be maintained. The current evaluation techniques of absence-presence designation is neither a sufficient nor meaningful measurement of environmental impact. A more useful monitoring process including evaluation of catch and habitat change is required. (Novakowski - 102,15674)

MOOSE

Moose are highly vulnerable to hunting, as witnessed by the fact that the moose population has already been reduced along the Mackenzie River Valley and in parts of the Porcupine River Valley because of the intrusion of man, (McTaggart-Cowan - 47,6205), and in Alaska along the Colville River (Lent - 111,16952-53).

In general, moose can be protected by incorporation of many of the protective measures applicable to caribou. These include measures to prohibit and prevent harassment, to facilitate movement of moose across the right-of-way, and restriction of firearms and hunting by pipeline employees. (Jakimchuk - 97,14724)

One geographic area of particular importance as moose habitat is located near Oscar Creek (at mile 365.9 on the Canadian Arctic Gas proposed route). This site is also an area that would involve removal of substantial borrow material (31 acres would be involved) which could have serious detrimental effect to the habitat of moose. (Mining - 79,11698).

A special problem that could arise with moose is that concentration of moose in winter along re-vegetated parts of the right-of-way could increase the possibility of overkill during winter hunting. This potential danger can be met by instituting certain protective measures, and more importantly, by sound game management, rigorously enforced.

RECOMMENDATIONS

1. Construction schedule should avoid any areas (97,14731-32; where moose move from their summer range to 99,15134-35) their overwintering area during the months of November and December. In areas of significant moose population construction should not begin until January and then under strict control.
2. The area in and around Oscar Creek (near (Jakimchuk - 97,14724) Milepost 365.9 of Arctic Gas) is particularly sensitive moose habitat and specific mitigative measures should be enforced if there is pipeline construction in this area.

3. Protective barriers and early backfill of pipeline trench should be practised in areas containing significant moose populations. (Whitney - 99, 15133-34)
4. Effective game management involving inventory, hunting regulations to maintain a balanced harvest, and regular surveillance are required to maintain a sufficient number of moose so that the species will not be seriously disrupted. (McTaggart-Cowan - 47,6205; Geist - 53A,7379; Lent - 11,16952-53; 99,15028-33)
5. Site specific evaluation should be conducted to more clearly identify areas of significant moose population. Special protective measures are to be employed in those areas where avoidance is not possible such as the sections of the right-of-way crossed by the moose to reach their wintering areas on islands in the Mackenzie River. (97,14731-32)

WOOD BISON

The wood bison, historically abundant but now rare, has been designated as an endangered species for purposes of international trade and to all intents and purposes within Canada as well. (Novakowski - 102,15645) The bison herd near Fort Providence is one of the two pure wood bison herds on this continent. Ensuring the integrity of the species must be regarded as an important end in itself. (Bouckhout - 100,15243)

The Foothills Pipeline proposed Yellowknife/Pinepoint lateral passes through the bison sanctuary. This route could affect further expansion of the herd and induce changes in ground water patterns in what appear to be bison overwintering areas. (Whitney - 100,15637-68) A further concern is the effect of aerial harassment on survival rates, particularly for calves separated from their cows. (Calef - 110,16817)

RECOMMENDATIONS

1. There should be no disruption or reduction of area in the Mackenzie Bison Sanctuary near Fort Providence because the bison herd is experiencing increased growth in this area. (110,16839 -41)
2. Aircraft regulations within the Mackenzie Bison Sanctuary should be strictly enforced. (Whitney - 100,15243)
3. A sanctuary should be created for the Fort Smith (Hook Lake) herd to reduce harassment and hunting which are responsible for its decline. (110,16841 -45)
4. Consideration should be given to the introduction of bison into new habitats to ensure breeding without being subject to human pressures. (Novakowski - 102,15675)
5. Studies in relation to bison use of highway, berms and snow cleared areas between Red Knight Hills and Yellowknife should be continued. (Whitney - 100,15243)
6. Population studies of bison in the Mackenzie Sanctuary should be continued and further studies of the impact that Foothills' proposed laterals may have on bison and woodland caribou should be undertaken. (Whitney - 100,15207 and 100,15279-8)
7. Further study of the effects of aircraft harassment on bison are required. (Whitney - 100,15243)

DALL SHEEP

The only large herding herbivores remaining in significant numbers in the western Arctic are the caribou and Dall sheep. Dall sheep are part of an ancient ecosystem which is historically significant and therefore particularly worthy of preservation. (Morlan - 55,7441).

Though Dall sheep are somewhat adaptable to human disturbance, man's activity must be regulated over a significantly long period of time to allow adaption and to prevent harassment. Given the fact that suitable Dall sheep habitat is confined to small, well-defined areas, a programme of protection and preservation can be evolved. The question of alternate routing and route selection plays an important role in the protection of the Dall sheep population.

Increased access and more widespread knowledge of the whereabouts of the winter ranges of sheep could result in overkill unless hunting is strictly controlled. Pipeline personnel must be regulated along the pipeline corridor to prevent an increase in the hunting of sheep. General subsistence hunting must be carefully regulated and a valid programme of game management instituted. The problem posed to Dall sheep is one of hunting as well as disturbance that comes from improved access. (Lent - 111,16952; McTaggart-Cowan - 47,6206; McTaggart-Cowan - 107,16338).

While the Cross-Delta alternative avoids significant populations of Dall sheep, the original Prime route (passing on the west side of the Mackenzie Delta) passes within one mile of the Dall sheep range in the vicinity of Mount Goodenough. (Jakimchuk - 89,13460) Considering all of the route alternatives proposed by CAGSL, the Fort Yukon Route would be the most disastrous for sheep populations because of the increased access to previously protected sheep habitat. (Geist - 54,7418-19).

RECOMMENDATIONS

1. While it is true that Dall sheep are adaptable if they are not subject to harassment, this adaptation is slow. Therefore, construction activity must not commence in sensitive areas all at once. Human and construction activity must be brought in gradually so that Dall sheep can complete their adaption to the impact (Geist - 54, 7412-14; McTaggart-Cowan - 107,16290-91)

of increased hunting, harassment by aircraft, snowmobiles, and direct entry of people into their lambing and post-lambing ranges.

2. Dall sheep dislike very loud noises and therefore suitable noise abatement equipment must be installed on all facilities within two miles of Dall sheep winter range. (Geist - 54, 7414; McTaggart-Cowan - 47,6219-20)
3. Aircraft and flight disturbance, particularly through the use of helicopters and any low-flying aircraft, may cause harassment with the resultant severe disturbance and loss of productivity of Dall sheep. Because of the limited area occupied by Dall sheep there should be regulation of aircraft operation. Flight paths of fixed-wing aircrafts should be set at 3000 feet above the ground, minimum, to prevent disturbance to Dall sheep. (Dau - 34,4473; Geist - 54,7415; McTaggart-Cowan - 47,6214)
4. Dall sheep are closely confined to small areas of suitable habitat. Hence, final route selection should identify and avoid these locations. (McTaggart-Cowan 47,6206)
5. No firearms should be permitted in pipeline camps or operating facilities. (McTaggart-Cowan - 108,16522)
6. A wildlife refuge of at least two miles on either side of the pipeline right-of-way and all access and supply roads should be established for protection of Dall sheep. (McTaggart-Cowan - 108,16522)
7. Along the proposed route the crucial lambing period is from May to mid-June. Lambing areas, wintering areas, and mineral licks used by Dall sheep must all be avoided by pipeline routes and access roads. (McTaggart-Cowan - 47,6219-20) (Jakimchuk - 89,16459)
8. The potential for disturbance of Dall sheep is great. It is the rare phenomena that excites a Dall sheep, not necessarily everyday activity. Therefore the problem of infrequent flights requires further study and research. (Geist - 54, 7417-18; 34,4473)

OTHER MAMMALSPOLAR BEAR

The polar bear is classed as an endangered species under the International Convention on Trade in Endangered Species. (Novakowski - 102,15677)

There are estimated to be more than 20,000 polar bears in the world, of which 15,000 are in Canada. The population of the western Arctic and Beaufort Sea areas would be approximately 1000 to 1500 bears. Canada is the only country in the world that allows any polar bear hunting and although the International Convention on Trade in Endangered Species has been ratified by Canada it is not currently in effect in all signatory countries. (Stirling - 122,18627-31)

Polar bears that inhabit the mainland coast, Amundsen Gulf and the west coast of Banks Island form one population, although there is a certain amount of exchange between the bears of the western Arctic in Canada and Alaska. The most important area for polar bears is the denning sites on the west and south coast of Banks Island and the moving ice areas along the coast. In these areas seals concentrate because they are tied to the breathing holes in the thin ice. Similarly the bears, which rely on the seals for food, are concentrated and any activity in that area would result in conflict. (Stirling - 122,18524-51)

New research has shown that most polar bear populations are fairly local. While they migrate north with the moving ice and do move back and forth as long as the ice remains intact, most populations show a high degree of fidelity to their area. During October and November, depending on freeze-up, the bears migrate south.

The most important aspect of the conservation and management of a species is the protection of the most important areas of feeding and breeding habitats. If that condition is met, the population can recover from a reduction in number. However, attempts to preserve the maximum number of individual polar bears would be of little value if the key feeding and denning areas were destroyed. The most important areas for the polar bears, and the seals upon which they depend, is the shear zone or area of moving leads that parallels the main coast and the west coast of Banks Island. During the open water period, the polar bears are absent in the more southern areas likely to be impacted by construction activity. However, during the winter construction season, bears would normally migrate to these areas. Although the possibility for an

encounter with polar bear is greater along the Cross Delta alternative than along the original Prime route, the possibility of encounter across the north slope of the Yukon and the Mackenzie Delta is a real one and the potential for damage to the habitat and food source of the polar bear must be recognized and met. (Stirling - 122,18524-51; Rowe - 133,20132)

Besides its obvious esthetic value, the polar bear represents a substantial component of the cultural and economic base of the Inuit of the western Arctic. Polar bear meat has been used as food and hides are utilized for trade and clothing. More recently, the hides have sold for up to \$ 3000.00 and therefore have a direct economic value to the Inuit in addition to their sociological and cultural values. (Stirling - 122,18524-51)

As with other bears, the polar bear will be attracted to sources of human food and is similarly in danger of being destroyed as a hazard to man even though there is a stated intention to protect this endangered species.

RECOMMENDATIONS

1. Critical habitat for the feeding and breeding of polar bears must be identified and offered special and total protection. (Stirling - 122,18524)
2. Protective measures must be designed to ensure the integrity and avoid impact of critical areas and food sources in addition to the avoidance of encounters with polar bears. (Stirling - 122,18524)
3. Offshore drilling and other activity in the Beaufort Sea poses a special and immediate danger to polar bears and must be regulated and controlled to the same extent and in co-ordination with any control over critical areas in the pipeline corridor. In particular, offshore drilling is taking place in the midst of the best of feeding areas for polar bears in the western Arctic and any protection measures must extend to such activity. (Stirling - 122,18524)
4. A study must be undertaken to determine the effect of an oil or other chemical spill on the polar bear including the effect on bears' eyes and the effect on the thermal capabilities of polar bear coats. Such a study should also determine whether bears are attracted or repelled from oil-fouled water. (Stirling - 122,18540)

5. The extent of maternity denning in the multi-year pack ice of the Beaufort Sea and the impact of activity on this denning must be studied. (Stirling - 122,18540)
6. With respect to the critical feeding areas, there should be no industrial activity between mid-October and mid-May. (Stirling - 122,18524-51)
7. Areas in which Inuit hunting occurs should be avoided during the period in which the sea is frozen. (Stirling - 122,18524-51)
8. Studies should be done to determine the reaction and effect of aircraft noise and other industrial activity on polar bears, including studies on the energy loss. (Stirling - 122,18524-51)
9. With respect to the denning areas, surface activities, such as seismic operations, should not be permitted within five miles of the coastline of Banks Island between October and the end of April. (Stirling - 122,18524-51)
10. Careful monitoring of polar bears and seals should be conducted, particularly during the initial stages of exploration and development. (Stirling - 122,18524-51)
11. A detailed study should be conducted on the effects of man, machines and industrial activities on polar bear behaviour and distribution. Such research should encompass a variety of areas to obtain quantitative measures of the importance of the disturbance, the degree to which bears adjust to the disturbance, what attracts the bears and the forms of deterrents that might be available. (Stirling - 122,18524-51)
12. Research should be conducted now to determine the baseline and present level of contamination resulting from heavy metals and PCB contamination. Because polar bears are at the top of the food chain they can serve as indicators of the degree of these contaminants in the total ecosystem. Upon establishment of firm baseline data, a constant and a regular monitoring programme should be devised to monitor the level of contamination. (Stirling - 122,18524-51)

GRIZZLY BEAR

In considering interaction between animals such as bears and pipeline personnel, it is important that authorities recognize that it is often the bear that requires the protection rather than the usual reaction to human fears from the "danger" caused by the presence of bears, wolves and other such animals. (Novakowski - 102,15632)

The barren ground grizzly bear is indigenous only to Canada and deserves protection. From the human standpoint a grizzly is a trophy animal. We must therefore develop procedures to ensure that grizzly bear encounters and conflicts are not used as an excuse to collect such trophies. (Novakowski - 102,15631 and 15710)

The grizzly, along with the polar bear, wolverine, wolf, fox and other flesh eaters will be attracted by edible refuse and strong odours. In those circumstances some will be killed in the guise of camp protection. Already vulnerable to excessive hunting and den site destruction we must develop procedures to ensure such artificial entrapment is not created. (McTaggart-Cowan - 47,6224; Webb - 116,17721-23)

The Canadian Wildlife Service and others are presently conducting more intensive studies of grizzly bear to provide the necessary baseline data for the evaluation of man-induced disturbance to grizzly bear populations. A long term data base is essential to detect the effects of man and disturbance to wildlife populations, in particular of the grizzly bear which is at the top of the food chain and often interacts with man. (Martel - 120,18332-38)

FOX

The red fox in the boreal forest and the white fox in the tundra areas are not directly threatened except in the immediate area of the pipeline corridor. However, the symbiotic relationship between the white fox, lemmings, seals and polar bears on Banks Island poses a special situation. The human population on Banks Island is almost entirely dependent on the white fox resource and the polar bear, seal, white fox interaction on the coastline is a delicate one that may become unstable if one component of the inter-relationship is disturbed. The pipeline and the oil and gas exploration in such areas as Banks Island increase the risk of disrupting this relationship. (Novakowski - 102,15619)

LYNX

The lynx population is cyclical and appears to be currently in a natural decline. This, added to the fact that the value of lynx pelts has skyrocketed over the last five years creates tremendous pressure on this animal. With increased accessibility produced by the pipeline corridor, the lynx population could be seriously threatened when it is already at a low point in its natural population cycle. (Novakowski - 102,15620)

MARTEN

Government documents covering a forty-year history indicate that marten is unevenly distributed over the areas proposed to be traversed by pipelines and is vulnerable to trapping pressure. Along with the beaver, marten is the major species in which the take has been regulated and many areas have been closed to ensure conservation of the species. The marten populations in the Anderson River area, as well as upstream along the Mackenzie River, are already under considerable pressure from the activities associated with oil and gas exploration and pipeline development. (Novakowski - 102,15621)

MINK AND OTTER

Mink and otter are both classified as fine fur and increased access creates the potential for over-harvesting. As both the otter and the mink are generally territorial, only local populations would be directly impacted by pipeline activity. It is important to remember, however, that these species are divided taxonomically into sub-species and population segments which have isolated gene pools. Therefore these animals, although distributed across Canada, have unique sub-populations which may be at hazard and, as such, are as much worthy of protection as the protection of a total population. (Novakowski - 102,15623-24)

FISHER

The fisher is a boreal species. That is, it inhabits a forest area. While found occasionally in the Delta, fishers are nowhere abundantly distributed in the Mackenzie system. Any large-scale habitat destruction, such as a forest fire, could have a major impact if the existing population became more concentrated as a result of such habitat loss and, hence, subject to increased trapping pressure. (Novakowski - 102,15618-19 and 15692-93)

WOLF

Wolves, along with other flesh eaters, are attracted by edible refuse and strong odours and, in fact, may habituate themselves to camp food sources rather than going to their wild food sources. (McTaggart-Cowan - 47,6224; 102,15670). In addition, wolves are vulnerable to excessive hunting and den site destruction. In the treeless areas, wolves are vulnerable to harassment by air traffic or other loud noises. (McTaggart-Cowan - 47,6224)

The wolf is another animal that is under pressure although the grey wolf as a species is not endangered. However, certain sub-species or sub-populations definitely are endangered and deserving of special protection. (Novakowski - 102,15649 and 15695)

It is important to remember that, particularly in the Northwest Territories, wolves are still harvested for their pelts and, hence, are subject to potential impact both as trophy animals and for their fur. (Novakowski - 102,15649)

WOLVERINE

While the exact distribution and population density of the wolverine has never been well documented and there are examples of widely differing estimates, the existing information does indicate that the wolverine is not abundant in the areas proposed for pipeline development. Various provinces in Canada are uneasy about the populations of what they consider to be a rare species and the governments of the Yukon and Northwest territories may yet take that approach. (Novakowski - 102,15621-22 and 15645-46)

Little is known and the research has been minimal. For that reason few generalizations can be made about these species and impact prediction is difficult. (102,15646-47) Special precautions, regulations and enforcement of protection must be taken re wolverine. (McTaggart-Cowan - 108,16515)

SMALL MAMMALS

Studies on microtine rodents, such as mice and moles, indicate the ecological significance of these animals as a group and the fundamental role they play in the food chain of other mammals and birds. (Jakimchuk - 89,13450-51)

The revegetated pipeline corridor with the consequent change in plant vegetation will increase the number of small mammals. At least temporarily, weasels, martens and other animals might be attracted to these areas. This concentration would increase the population density and, hence, make them more vulnerable to over-harvesting. (McTaggart-Cowan - 108,16515)

RECOMMENDATIONS

13. The grizzly bear is deserving of special protection and a scheme for international co-operation in its management should be entered into before major activity affecting the grizzly bear habitat is commenced. (Novakowski - 102,15677 and 15710)

14. A management scheme should be designed to protect the lynx, particularly in its anticipated period of natural population decline, and should be instituted to ensure that increased access to pipeline-related activities does not dangerously deplete the naturally diminishing population. (Novakowski - 102,15620)

15. A management scheme should be established for the protection of small mammals such as weasels, martens and fisher, to take into account the fact that such animals may be attracted to the pipeline right-of-way because of the anticipated increase in microtine rodents. (McTaggart-Cowan - 108,16515)
(Novakowski - 102,15618-19)
(Jakimchuk - 99,15029-30)

16. Since much of the food of mink and otter is obtained from the aquatic environment, water quality control techniques and standards of protection should take into account the existence of these mammals and their special requirements with respect to habitat and food. (Novakowski - 102,15623-24)

17. Special precautions should be devised for Banks Island taking into account the delicate inter-relationship between white fox and the seals, polar bear and lemmings in that unique environment area. (Novakowski - 102,15619)

18. Because of the lack of reliable data on population density and distribution of wolverine and the potential threat imposed by increased accessibility, research should be conducted into the population and distribution of the (Novakowski - 102,15693-94 and 15646-47)

wolverine and a game management scheme devised to ensure its protection and survival.

19. There undoubtedly will be conflicts between the utilization of gravel sources and river beds and the use of upland borrow sites and between alternate borrow sites. The resolution of such conflict must take into account vulnerability of wolf, fox, and bear to disturbance of or destruction of traditional denning sites. Alternate borrow sites should be utilized in situations where the preferred borrow site is shown to be the location of dens. (Minning - 81,12078; Hemstock - 80,11883)

20. Should borrow be required from an area containing dens of bear, fox or wolf such operations should take place in the seasons and during the times the dens are not in use and should avoid the disturbance or alteration of the den sites. As a general rule, operators should work on the north side of deposits where there are likely to be fewer dens. (Jakimchuk - 89,13463; Hemstock - 80,11883) (Minning - 81,12078)

21. The proposed borrow site area 452 at milepost 92 (two miles south of Sitidgi lake) has been identified as an important denning site for bears. This area is particularly sensitive and should be avoided through appropriate route selection. (Whitney - 99,15130-31)

22. Because of the significance of denning sites and the availability of alternate borrow sites the environmental consultants should be able to veto borrow site locations in particularly sensitive areas. (88,12421)

23. In situations where large mammals such as bears, foxes or wolves are lured to campsites, the practice of tranquillizing and removing the animals to more remote areas is to be adopted rather than the killing of the animals. (Jakimchuk - 95,14362)

24. No hunting of grizzly bear for trophy should be permitted and, in particular, no spring hunting of grizzly bear be permitted. (McTaggart - Cowan - 47,6210)

25. The hunting of wolves for bounty should be curtailed in certain areas and the hunting of wolves by any persons not specifically licenced be prohibited. (Novakowski - 102,15649 and 15695)

26. There should be a strict policy that there be no hunting, fishing or trapping by any employees of the pipeline or its associated activities brought into an area. (Hemstock - 95,14366; Jakimchuk - 95,14366)
27. There should be a strictly enforced wildlife refuge of at least two miles in width, extending on each side of the pipeline right-of-way and all access and supply roads. Such a refuge would ensure that there was no fishing, hunting or trapping within the wildlife area except for the trapping and traditional hunting and fishing of the residents of the area who have occupied or used the area for three years prior to construction and as long as such hunting, fishing and trapping was part of their livelihood and not a commercial enterprise to satisfy pipeline requirements for food. Such a closure not only has biological benefits to overcome dangers created by an influx of personnel and access to previously remote areas but it has a political benefit in that it ensures that pipeline workers will not have access to game and fish population which the general public cannot reach. (McTaggart-Cowan - 47,6220-22; 47,6210-11; Lent - 110, 16873-74)
28. There should be strict restriction on the use of compressor station airstrips that would ensure there would not be harassment of wildlife from the air and that would preclude the use of these airstrips as staging areas for hunting, fishing or trapping activities. (McTaggart-Cowan - 47, 6217-18; Jakimchuk - 95,14370)
29. No firearms should be permitted in pipeline camps or operating facilities except for sealed firearms required in the event of camp emergency. Such firearms could then only be used by authorized personnel and under strict control. (McTaggart-Cowan - 47,6210; Jakimchuk - 95,14362)
30. There should be rigorous adherence to the highest standards of garbage and waste disposal. This should include incineration of all edible waste and removal of all garbage and waste not biodegradable. Food must be stored at a location and in a manner where it will not attract wildlife. Incinerators must be initially designed to take a capacity in excess of anticipated camp requirements to avoid even temporary pile ups of garbage. (Jakimchuk - 95,14365; McTaggart-Cowan - 47, 6210-11 and 6217-18)

31. There should be strict enforcement of all anti-littering and waste control procedures and no garbage or waste should be disposed except in authorized areas and according to authorized procedures. A programme of constant surveillance during the construction period and an active programme to reduce garbage and review garbage disposal techniques should be instituted. Because of the unique wilderness areas to be traversed increased research and management of garbage and waste disposal beyond that normally required in construction of this type should be implemented.

(McTaggart-Cowan - 47, 6209; Novakowski - 102,15631; Bouckhout - 88,13523; Lawrence - 88,13254)
32. All areas of camp activity and in particular areas involving food or garbage disposal or any other area where there is a possibility of adverse interaction between the pipeline activities and the natural wildlife, should be fenced off so that there is no contact between the hazardous situation and the natural wildlife of the area. In addition, areas containing fuel bladders must be fenced to protect them from possible rupture by bears.

(Jakimchuk - 95,14366 and 14362; McTaggart-Cowan - 47,6210-11; 98,14885; 47,6207-08)
33. Procedures must be adopted to avoid and prohibit contact between pipeline personnel and wild species in the area. This would include a prohibition against feeding wild animals (bears, foxes, wolves, etc.) or approaching them for photographic or any other purposes. These prohibitions would apply both within the work site areas and anywhere within the two mile wildlife refuge on either side of the pipeline facility. Strict enforcement must be maintained by the pipeline company and stiff penalties levied for violation.

(McTaggart-Cowan - 47,6210-11; Jakimchuk - 95,14360-61; McTaggart-Cowan - 47,6222; 95,14360-61)
34. Electrical monitoring devices should be used at compressor stations and other locations to detect bears and other animals that may enter and potentially cause damage or disrupt activities.

(Novakowski - 102,15681-82)
35. The grizzly bear on Richards Island are in particular danger of harassment through hunting and loss of habitat due to gas plant feeder line systems. A particular programme of investigation to limit harassment and a monitoring of effects on these bears should be implemented.

(102,15675-80)

36. The denning sites of grizzly bear must be avoided by pipeline route selection and by borrow pits. (McTaggart-Cowan - 47,6210)
37. Polar bear sites must be located and protected during pipeline activity because polar bears are extremely sensitive to disturbance, in particular in the vicinity of their dens, with the resultant reduction in their reproductive success. (Weedon - 54,7478; Jakimchuk - 95,14362)
38. Information on denning sites for such animals as fox can be quite specific and should be gathered early during pipeline facility site selection, avoiding such sites where possible. (Hemstock - 83,12420)
39. Banks Island must be recognized as a special situation because of its sensitive relationship between lemmings, fox, seal and polar bear and the resultant impact on the community as a result of any disruption of this relationship. Special regulations dealing with Banks Island should be developed. (Novakowski - 102,15619; 102,15667)
40. A wolf management programme must be established throughout the Northwest Territories. The success of such a programme would be greatly increased if there was no road built in conjunction with the pipeline. (McTaggart-Cowan - 47,6222 and 108,16515-16)
41. Further studies should be carried out on the impact of seismic activities on foxes and other such mammals to gain an insight into environmental impact of pipeline activities. Much insight can be gained by monitoring existing activities in the area and a concerted effort to gather and interpret this information should be undertaken. (102,15668-71)
42. Grizzly bears, polar bears, wolves and wolverine inhabit the area of the proposed Arctic International Wildlife Range. For the purposes of preserving these and the other animals in the unique ecological character of the Range, this land should be given special protective status. (54,7480)
43. Because of the lack of solid, long-term data to evaluate the impacts of man and man's activity on grizzly bear populations, the onus should be placed on the applicant wishing to initiate a development to demonstrate the im-

pact of his proposal. This can only be accomplished through accumulation of a long-term data base and, therefore, such necessary research, gathered in a comprehensive way, must be available before approval is granted for the utilization of particular techniques to avoid impact on grizzly bears.

44. A rational wildlife management scheme should be evolved to take into account the changed social as well as the changed biological situation. Such a wildlife scheme would require the co-operation of various levels of government and would deal with such problems as harvest levels of fur bearers, protection of trapping rights of existing and prospective trappers and the obtaining of up to date and accurate information on the species and its utilization to ensure unnecessary environmental and resource use destructions are eliminated and to give meaning to after the fact monitoring and surveillance. This data gathering procedure, combined with resolute enforcement, must be carried out through the involvement and with the co-operation of all northern residents.

(McTaggart-
Cowan -
47,6210-11;
Novakowski -
102,15624-6)

MARINE MAMMALS (WHALES AND SEALS)

The bowhead and beluga or white whales constitute a significant and endangered group of arctic marine mammals, important in their own right but also valuable to the people who rely on harvesting these animals for their livelihood.

The current estimate of bowhead whales in the Beaufort Sea portion of the Arctic Sea is about 100 animals. This low number is largely due to the actions of whalers who, at the turn of the century, overharvested these animals almost to extinction. At present there is a prohibition against taking any of these animals. (Bliss - 112,17126) There is not an accurate census of the population of beluga whales. It is estimated that there are about 5000 belugas in the Beaufort Sea, however this figure may not be sufficiently accurate to be used for management of the yearly harvest. (Webb - 116,17748, 17753).

Whale distribution appears to be determined in part by ice conditions at the time of observation. Whales arrive in the Mackenzie River estuary area in late June or early July and stay until mid-August. Their tendency is to seek out the shallow areas in the mouths of main channels, presumably because of beneficial effects of the warmer Mackenzie River waters. Their numbers varied from approximately 1500 in 1974 when ice conditions were more severe to about 4000 in 1975.

It is possible to detect a pattern to whale movement when they are in the area of the Mackenzie Delta. Generally they arrive first in Shallow Bay; however, in the years when the ice pack was a little late in breaking up, they arrived almost simultaneously in Shallow Bay and Kugmallit Bay. In the years they did arrive first in Shallow Bay, there was a tendency for the Shallow Bay animals to move around the Delta, staying fairly close to shore with some of those ending up in Kugmallit Bay.

They generally stay in the mouth of Shallow Bay or offshore from the mouth of Shallow Bay between the first and third week of July. They depart to areas primarily north and east, generally shifting up towards Garry Island. They are not stationary while in the bay. Their daily movements include travel out from the shallow water to deeper water, and back again. Although they are fairly sedentary at this time of year compared to other times, they do move ten or fifteen miles from that location quite often. (Webb - 116,17661 - 63).

Whales have been sighted some twenty or thirty miles from the end of Shallow Bay, as far as the mouth of Reindeer Channel. Researchers feel that this movement is in response to hunting pressures as the whales seemed to be able to distinguish very well the sound of an outboard motor and associate that with pursuit and their own survival. Therefore they are very reluctant to be trapped in shallow waters, so will move out into deeper waters where they can feel more secure. The response, on the other hand, to barge traffic was to display curiosity and move up to the barges. (Webb - 116,17664 - 65).

When consultants to the Delta Producers were conducting their studies, there was a considerable amount of barging and boating activity in the Mackenzie Bay area related to the construction of offshore islands. According to Webb, in the case of Immerk, whales were found very close to the island during the construction period. In his view, the whales were only disturbed when a boat of any description, including barges, seemed to be pinning a whale or pod against the shallow shoreline in which case they would retreat to sea, returning later. (Webb - 116,17665 - 66).

The Canadian Arctic Resources Committee wants to stress that no direct disturbance studies on whales were conducted, the assessment being limited to observation of whales' responses to boat traffic, dredging for islands and low level aircraft surveys. Because these disturbances appeared to cause merely localized response which did not cause the whales to leave an area, the Delta Producers' Consultants appeared to regard them as irrelevant. (Webb - 116, 7668 - 70).

The Mackenzie Delta area must be regarded as an important beluga calving area despite the fact that very little is known about the precise location at which these whales calve. The general indication is that it is wherever they are during the first week or two of July, as long as it is in shallow water which is generally warmer water and offers protection from wave action. Webb believed that calves were dropped in all areas where whales were observed to concentrate: Shallow Bay; off Garry Island; the center of west Mackenzie Bay; and Kugmallit Bay. (Webb - 116,17666 - 68).

In view of the importance of this area, merely because a disturbance does not cause immediate dislocation of the whale population, the potential for disturbance should not be regarded as irrelevant. Experiments conducted at Churchill indicated that while white whales can tolerate human noise and activity, calving concentrations are more sensitive to human disturbance. For example, the Churchill River, once used as a calving area, has been abandoned in favour of the smaller Seal River, even

though the whales continue to use the Churchill Estuary as a feeding site. The only explanation for this change of calving areas appears to be the increase in human activity. (Sergeant - 121,18480 - 81; 122,18672 - 74). The Mackenzie Delta, in Sergeant's opinion contains very little in the way of feeding requirements for whales, leading to the inference that its prime importance is its suitability as a calving area (121,18478 - 79). The Delta Producers' consultants have commented that:

"The apparent variability and the reaction of whales to boats may be the result of a number of factors. For example, water depth, nearness of obstacles such as shallow water or land, boat type, boat speed, traffic intensity, recent experience of the whales and whether or not the whales are pregnant or accompanied by a calf. These factors, either singly or in combination could reasonably be expected to result in a change in the response of whales to the presence of a boat." (Slaney, 1975, Whitewhale Study, p. 37)

The weakness of this assessment, even if it is a good summary of the cause of disturbance to whales, is that it does not determine the degree of disturbance or the long-term impact with regard to whether the whales will continue to return to this area, and whether in fact it is a crucial area for calving and maintenance of the population. (Sergeant - 121,18482).

Sergeant believed that increasing disturbance, especially the construction of more offshore islands, could result in whales leaving the Mackenzie Delta region to attempt to calve elsewhere. Since there are no alternative rivers in the neighborhood of the Mackenzie that can receive a large number of whales, it must be considered that continued maintenance of the whale population depends very heavily on the delta habitat. The population of white whales which calve in the Mackenzie Delta region is virtually the whole of the population in the Beaufort Sea. Oil and gas activities throughout this region in July each year could so disrupt the whale herd that they would be unable to reproduce successfully and in time the herd would die out. (Sergeant - 112,18495 - 97).

There are two major concerns involving whales of the Beaufort Sea with respect to the cross-delta pipeline route. The first of these is water-transmitted noise associated with pipeline construction and operation. Little, if anything, is known about the effects this noise could have on the whale population in terms of stress and dislocation. Milne regarded future levels of summer noise and activity from machinery,

ships and aircraft as more harmful to white whales than oil pollution. In his view, if high noise levels were focused in Shallow and Kugmallit bays, the whales could be forced into less suitable calving grounds. (124,18984). In Sergeant's opinion, it is necessary to determine the sound pressures and frequencies which disturb whales in different situations before exposing them to a great deal of human activity in the Delta area. (121,18481 - 82).

The combined activity of dredging and pipe installation in the Shallow Bay crossing, by creating something close to a physical obstruction for the whales, would essentially preclude the whales from entering Shallow Bay above the crossing. This barrier would serve to displace the whales seaward some distance. (Sergeant - 122,18621). If the whales were displaced to cold water and could not calf, or if due to lack of an insulative blubber layer the calves could not survive, there would be a loss of perhaps 60% of that year's calf crop. While this would likely have no long-term effect on the overall population, a decline produced by a number of years disturbance would lead to a very slow recovery because of the longevity and slow reproduction rates of the species. (Sergeant - 122,18678, 87 - 89). Exclusion of the herd from the Delta area would certainly have a profound effect on those people dependent on whaling such as those at the Whitefish Station (116,17752).

The major concern then is that the whales could be permanently expelled from their calving grounds by the combination of water-borne activities produced by increased development and the rising levels of activity in the Delta area. This possibility has led Sergeant to propose that a sanctuary be established in the western part of the Delta where the main aggregation of whales is found in July. This would prevent the calving animals from being subject to disturbance throughout the whole Delta simultaneously. (122,18494).

Although an oil spill would not have as severe an effect upon whales as on other species, notably birds, it would have long-term effects on respiratory and digestive systems, eyes, and other sensory organs. (Sergeant 122,18618 - 9). Oil contamination of the nearshore waters of the outer Mackenzie Delta is probable during the calving season. If the whales are forced to leave the contaminated part of the estuary, this interruption could reduce the survival rate of calves for that season. Subsequent recovery could be a matter of years (Milne 124,18983 - 4). An oil spill or contamination would also severely affect aquatic invertebrates, a major food source for beluga whales, sea birds and fishes as well as seals (Milne - 124,18984; Snow - 125,19129).

The ringed seal and to a lesser extent the bearded seal provide an important source of protein and part of the annual

cash income of most Arctic coastal villages including: Tuktoyaktuk, Paulatuk, Sachs Harbour, Holman Island and Coppermine. However, few studies have been conducted in these areas. (Smith - 122,18497 - 98).

Contrary to previous assumptions, the evidence indicates that the annual production of ringed seal can fluctuate greatly. While the exact causes are not known, these fluctuations probably relate to annual fluctuations in marine productivity (Smith - 122,18510).

Research conducted to date is not sufficient to predict the effects of industrial development on ringed seals in the Beaufort Sea and especially not the effects of a general disturbance by an increasing occupation of the area. However, it can be expected that increased activity during the summer and fall, when seal populations are moving, would have serious effects such as changing the seasonal distribution of seals. This could result in increased natural mortality or shifts of whole populations out of an area. The creation of a North Sea type of offshore oil field in the southeastern Beaufort Sea, with its attendant disturbance will certainly affect the seasonal pattern of movement and dispersion of seals. Smith feels strongly that the Beaufort Sea and Amundsen Gulf areas are one system and that the mobility of the marine mammal populations in these regions is important for their continuing well being. The possibility of barriers to movement caused by a large scale development such as an offshore oil field cannot be discounted even though they cannot be tested experimentally "before the fact". (Smith 122,18500, 10, 12).

Oil pollution in the Beaufort Sea poses a grave threat to seal populations. Because of the seal's dependence on an ice-fast habitat for eight months of the year, they would be exposed to oil for a long period should an under ice blowout occur. The major long-term effect of such a blowout would be a contamination and reduction of the seal's food species. It is known that seals suffer a higher mortality due to oil contamination when they are stressed by other factors such as lack of food, disturbance or moulting. (Smith - 122, 18513- 4; Milne - 124, 18974 - 5). An oil spill also has the potential of fouling birth lairs causing a high infant seal mortality (Smith - 122,18640 - 41).

Offshore leads are critical to survival of overwintering ringed seals and breeding and feeding bearded seals. These leads appear to follow shear zones and should be avoided insofar as industrial activity is concerned. (Smith - 122,18711 - 2; Milne - 124,18975).

In summary, very little is known of seal movements and response to disturbance and pollution. Considerable research is necessary before increased activity in the Delta is allowed.

RECOMMENDATIONS

1. Because there is little time to gather precise information on human activity and whale disturbance, a sanctuary should be created in the western part of the outer Mackenzie Delta which would be totally free from all disturbance including hunting, construction of artificial islands and of a gas pipeline. (Sergeant - 122,18494)
2. Island construction should be suspended during the summer when whales are calving. (Sergeant - 122,18495)
3. Islands should be spaced a considerable distance apart. (Sergeant - 122,18495)
4. A limit should be imposed upon the number of islands constructed in the near-shore parts of the Beaufort Sea. (Sergeant - 122,18495)
5. Measures which will ensure successful annual whale reproduction must be initiated before increased oil and gas activities are allowed in the outer Mackenzie Delta. (Sergeant - 122,18496 - 97)
6. Offshore drilling should be delayed until further detailed studies on the effects of contact with crude oil on ringed seals and whales have been conducted. (Smith - 122,18513)
7. On the basis of information from future studies, specific recommendations for the avoidance of critical areas and the cessation of activity during critical time periods should be made. (Smith - 122,18514)
8. No industrial activity should be allowed at key seal feeding areas between mid-October and mid-May. (Stirling - 122,18547 - 8)
9. Shipping and barging corridors should be established as a means to protect whale calving areas. (Sergeant - 122,18684)
10. All industrial activity should cease during periods when environmental conditions are detrimental to seals, such as during periods of oil pollution, to avoid imposing additional stress. (Milne - 124,189745)

11. The following Arctic Gas recommendations should be imposed on any cross-delta route:
(Webb - 133,20157)
 1. That construction activity take place after the majority of the whales are observed to have left the area.
 2. That supervisory monitoring surveys be undertaken of both whale distribution and hunter harvest success.
 3. That boat traffic, particularly barges hauling gravel from Shingle Point, occur after 1 August.
 4. That aircraft overflights of West Mackenzie Bay at low levels be avoided in late June and the month of July.
 5. That aircraft and boat landings at whaling camps be kept to a minimum.
12. If a cross-delta route is approved, it should be the route furthest from the mouth of Shallow Bay.
(Webb - 133,20182)
13. Because overlap of critical periods for bird migration and whale calving in the Delta occur during the summer, winter construction should be required.
(Sergeant - 122,18690 - 92)

FURTHER STUDIES

14. To monitor the effects of disturbance on seals, the following research programmes should be conducted:
(Smith - 122,18514 - 6)
 - Annual studies of stress indicators in freshly captured or shot seals.
 - Programmes should be designed to monitor primary and secondary productivity periodically throughout the year, and from year to year, over a large part of the Beaufort Sea.

- The collection of accurate statistics on catch per unit of effort in the important seal hunting communities to determine if the exploited seal stocks have been or are diminishing; this would help to determine whether there has been a decrease in hunting effort from year to year, which occurs frequently in Arctic communities.
 - The collection of an adequate age sample of seals from the important hunting communities should be done on a yearly basis to document shifts in production or in certain age segments of the population.
 - The annual surveying of hauled-out seals during the initial development of the oil field to obtain population estimates, especially in the critical shear zone or transition area.
 - The continuation of the breeding habitat survey started in 1974 which is the best single indicator of ringed sealed productivity. This involves flying to pre-selected points in the Amundsen Gulf and searching these ice areas using a trained dog which is able to pick up the subsnow birth lairs and actually quantifying the number of birth lairs per unit of fast ice.
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- 15. Further studies of whale populations and harvest are required to properly manage the whale population of the Beaufort Sea. (Webb - 116,17727)
 - 16. Further studies of the effect of human and industrial activity on whales is required to arrive at acceptable harvest levels which will ensure their continuance. (Webb - 116,17752)
 - 17. Further study of the biology of whales in the Delta region is required. (Martell - 120,18336)
 - 18. Further study of the effect of water-transmitted sound on whales is required before exposing them to increased activity in the Delta area. (Sergeant - 121,18481 - 82; 121,18492 - 93)

19. The combined efforts of starvation on ringed seals and additional stress imposed by the presence of oil in the water should be evaluated. (Smith - 122,18513 - 4)
20. Further studies on the chronic effects of oil on seals, particularly a consideration of damage to eyes and kidneys, should be undertaken due to the possibility of a long period of exposure should an under-ice blowout occur.
21. Information on the pattern of seal movement and possible migration is required in order to minimize the adverse effects of offshore oil development on seals. (Smith - 122,18514)
22. A series of integrated studies directed to specific trophic levels of the food chain, including the consuming native people, should be conducted to gain more knowledge of the factors that control natural variation. These long-term studies are necessary to understand the effects of man-induced influences. (Smith - 122,18516 - 7)
23. Monitoring of polar bear and seal populations should be undertaken especially during initial stages of exploration. (Stirling - 122,18548)
24. Further research on heavy metal and P.C.B. contamination of polar bears and seals should be conducted. (Stirling - 122,18550)

BIRDS, General

(see separate recommendations on waterfowl
and on rare and endangered bird species)

Pipeline routes proposed by Canadian Arctic Gas traverse many areas that are significant and important to North American bird populations. For example, on the Yukon north slope, there are approximately 100 bird species. Each of these species has a different life history, food requirement, habitat requirement, migratory route and incubation time. Potentially, then, they may react differently to disturbance and may be vulnerable at different time periods. The Prime Route generally parallels the Beaufort Sea coast which on a seasonal basis supports large numbers of birds and marine mammals as well as fish. Unique and productive in-shore lagoons are extremely important for migrating and nesting birds as well as food chain production based on an early algae bloom on the sub-surface of ice. The movement of birds as well as long-shore circulation patterns interrelate with all aspects of this ecological system. (Weedon - 54,7473; 97,14834-36)

The Mackenzie River estuary is one of the most important breeding grounds for Canada geese as well as for other waterfowl such as certain species of swans and ducks. (Leonard - C-23, 2316-17) The baseline ornithological studies conducted by Arctic Gas established the important point that in the spring, waterfowl tend to follow closely the Mackenzie River which opens before the adjacent icebound lakes. Many species of birds make considerable use of the islands in the lower river for feeding, nesting and mating. By contrast, in autumn, the lakes are still open and provide good food sources; in consequence they are extensively used by autumn migrating waterfowl. (Gunn - 89,13410)

While inanimate objects, such as compressor stations, are unlikely to have any direct impact on bird populations, the sound of these stations and the human presence together may create a more serious impact on bird populations. It is difficult to predict the effect noise will have on birds and impossible to generalize their reaction in this respect. (Gunn - 93,14148; Fielder - 42,5415) In terms of disturbance, it is not so much a matter of scaring the birds but that they may leave their eggs exposed to possible predators at the time a disturbance occurs. For that reason, questions of access, particularly to critical areas, and aircraft activity are of major concern. (82,12146) Increased human activity and access into areas hitherto isolated have caused the greatest concern to ornithologists. A road is the most uncontrolled

of all possible elements in any transportation corridor, as far as disturbances to birds are concerned.

Aside from disturbances that would result from pipeline construction, during pipeline operation surveillance flights would be required at fairly regular intervals, including during times particularly sensitive for birds. (Hemstock - 82,12265) This activity, unless controlled as to time, aircraft pathways and minimum heights, poses a potentially serious threat to the bird population. It was also recognized by Arctic Gas that aerial seeding operations have the potential of disturbing birds, especially if there is any type of concentration of birds, such as on a shoreline or around a lake. (Dabbs - 81,11967; Dabbs - 82,12146)

Protection of birds and mammals from disturbing activities can be accomplished by careful route selection and adequate enforcement of regulations designed to protect the bird populations. Such regulations would include:

- (i) Planning and execution of all activities in work areas to avoid degradation or alteration of the critical environment;
- (ii) Placing specific restrictions on terrain disturbance;
- (iii) Declaring certain areas off limits;
- (iv) Prohibiting disturbing activities in specific areas during specific periods of time; and
- (v) Restricting operations to avoid interference with migration. (McTaggart-Cowan - 48,5392)

In general, the Canadian Arctic Resources Committee urges that there be adoption and implementation of the major recommendations of Dr. Gunn, the chief ornithological consultant to Arctic Gas. Other recommendations that apply to birds generally, in addition to those proposed separately for waterfowl and for rare and endangered species, are listed below.

RECOMMENDATIONS

1. The evidence that ornithologists have presented at this Inquiry has focused on the importance of the Yukon North Slope, the Mackenzie Delta and the Old Crow Flats as habitat for birds. For this reason, and for various other environmental reasons, the Canadian Arctic Resources Committee is recommending that no pipeline route be approved

across the Mackenzie Delta or through the northern Yukon north of the Porcupine River.

2. If a pipeline is ordered to be built along the Yukon North Slope, steps needed to protect bird habitat include:
 - (i) The Shingle Point borrow site should be re-examined and re-located away from its present location in critical bird habitat. (A1, 11963-64)
 - (ii) In no instances are the sandbars in the Mackenzie River and the existing spits, bars and barrier beaches on the north slope to be used as borrow sources. (80,11902-03)
 - (iii) A detailed manual for field personnel should be prepared describing the staging and moulting of migratory birds along the north slope coast and the procedures to be followed to avoid disturbance, including times when no activity in the area is to be allowed. (Hurd - 41,5332-33)
 - (iv) Unregulated traffic within the coastal lagoons of the north slope must not be permitted so as to protect the staging and nesting areas. (McTaggart-Cowan - 48,6391-92)
 - (v) That at no time would a highway or other permanent road access be permitted on the north slope and into the Mackenzie Delta. (Gunn - 90,13654)
3. Pipeline workers and other personnel should be confined to the work area and prohibited from hunting waterfowl or other birds. (Gunn - 90,13653)
4. Should additional facilities be required, because of expansion or looping, these facilities should be located at the sites already disturbed so that extensive disturbance is limited. (Gunn - 90,13653)
5. The timing and procedure for aerial seeding should be reviewed and approved by ornithologists and, in no instance, would seeding be allowed over critically sensitive areas or large concentrations of birds. (81,11967; 82,12146)
6. Withdrawal of water should be approved by ornithologists and all shallow lakes significant for duck nesting be avoided. (85,12622)

7. Construction must be restricted to the winter season after the fall migrations have been completed and prior to spring arrivals. (Gunn - 98,14866-69)
8. Aircraft flight corridors which avoid high density wildlife habitat or critical wet land habitat areas should be prepared and enforced. (McTaggart-Cowan - 48,6391; 100,15264-65)
9. All corridors and flights from 15 May to 15 October should be reviewed and approved by an agency familiar with the ornithological implications of such flights. (McTaggart-Cowan - 48,6391)
10. Studies should continue to determine critical areas or particularly sensitive areas for birds. If outright avoidance of those critical areas by the pipeline route is not possible, measures should be implemented to minimize the long-term impact. Ancillary facilities to the pipeline, such as air fields, compressor stations, gravel pits or staging areas, are to be re-located out of critical areas. (Gunn - 98,14866-69)

BIRDS OF THE MACKENZIE DELTA

There are about 100 different species of birds which use the Beaufort Sea or its littoral zone. From work done in the past several years it is estimated that there are approximately 2,000,000 migratory birds that frequent this area. This data is based on ground based observations of migrations, aerial surveys and radar observations. Estimation difficulties stem from the vagaries of weather, visibility and an ever changing mobile population. These surveys covered the southern part of the Beaufort Sea from the coastal lagoons to about 200 miles to sea.

There are several species of water birds, for which the shores and marshes are the principal nesting grounds. For large numbers of sea birds, the coastal bays, the lagoons, the barrier beaches and the islands are important for nesting and moulting. For seabirds migrating along the coast, the open water leads in the sea ice are traditional places for resting and feeding. Open water leads form along the coast and allow a migration route which the birds traditionally follow almost every year. The migration routes and number of birds involved were outlined in detailed evidence before the Inquiry. (Barry, 121, 184438-41)

Perhaps the most valuable species found in the Delta area is the lesser snow goose, an important food source for the residents of Tuktoyaktuk. Snow geese arrive in the spring by way of the Mackenzie Valley, stopping at various places, especially along the river where the first open water occurs. They move to the outer part of the Mackenzie Delta and further north during the latter part of May, following the main channel of the Mackenzie then to Kitigayuit and along the Tuk Peninsula to Banks Island. They arrive at Banks Island towards the end of May and begin nesting by the first of June. Approximately 200,000 snow geese nest in these grounds inland from the coast. Two sub colonies are located in the Anderson River Delta and the Kendall Island area in the central part of the Mackenzie Delta. These colonies may be regarded as somewhat less suitable than the main Banks Island colony as they are low-lying and subject to spring floods and storm tides in the fall.

The fall staging areas for snow geese are the Mackenzie Delta westward into Alaska, and in some years, Bathurst Peninsula. Geese are grazing birds, feeding to a large extent on the grasses and sedges of the low flats of the Mackenzie Delta, although

they also go upland into the slopes of the Yukon and Alaska. This particular area in the fall is very sensitive. A storm tide could carry any large spill onto the land. If this should occur virtually every snow goose in the western Arctic would be affected. If the geese are disturbed or if their food supply is destroyed by residue of oil entrapped on the flats, that would just about eliminate their ability to gain enough weight to continue their migration. It is important that they are in good physical shape leaving the Mackenzie Delta, because they very rarely stop along the Mackenzie River or on the lakes on the way south. When they leave this area they have usually gained one pound in the course of 20 to 30 days. The impact of a pipeline through the outer delta's prime nesting and staging area would be severe though difficult to accurately predict and assess.

Other species representative of the Beaufort Sea are the eiders, both the king and the common. They winter in the Bering Sea in the north Pacific and in early spring, follow the ice leads around the coast of Alaska along the Beaufort Sea to nesting grounds, located in the Arctic Islands and along the coast as far east as Queen Maud Gulf.

The migration route of the eiders as well as others such as old squaws and loons are the previously mentioned ice leads which provide a place to stop either to rest or feed during their migrations. These ice leads are important only during the spring migration which occurs around the first of May to early June - some migration actually begins in April. It is important to consider this fact since a sea bird may be flying for literally hundreds or even thousands of miles over ice before it finds anything that even looks like water. The attractiveness of open water to first-arriving birds is true, not only along the coast, but also along the Mackenzie River in the pre-breakup stage. So it is particularly important that what they are not in fact seeing is a large pool of oil rather than water. The critical period for eiders lasts from about 25 April when the males first arrive until the end of the migration to the eastward, which terminates around the latter part of June. However, there is continual migration of eiders throughout the season, either east or west, right up until freezeup. These ducks feed primarily on the bottom of the ocean and although we are not sure of their feeding habits at this time (we do know they take clams and probably Marine isopods), what an undersea contamination might do to the chain of this particular species is presently unknown. The offshore drilling locations are practically on the fringes of the bird migration route which must be regarded as a particularly sensitive area considering the easy confusion between open water and an oil spill.

Other sensitive areas for migratory birds in the Beaufort Sea are the coastal lagoons, bays and barrier beaches and the tidal

marshes from June through late September, and even actually into October and to freezeup. These provide rearing areas for birds that nest either on the marshes or on the periphery of these areas. The young are frequently taken to water where they feed and develop. It is also a moulting ground - all ducks, geese and swans moult in the summertime. They lose all their flight feathers and become completely helpless. For protection, large flocks get into the bays and lagoons and become flightless for a period of 30-45 days, depending upon the species. Because they are unable to fly, any oil spill or contamination of these barrier beaches or the lagoons will result in the destruction of whole flocks, which are usually quite concentrated at this time. From August through to September, the coastal marshes and the barrier beaches are staging areas. These fall staging areas, especially the outer part of the Mackenzie Delta, and along the north coast of the Yukon and the Tuk peninsula, are important to snow geese, white fronted geese, brant and many ducks.

Another group of birds that must be considered unique are the cliff nesting murre. The only colony of these birds in the Beaufort Sea area is found in the small Cape Parry bird sanctuary near the Parry DEW line site. They are marine feeders, completely controlled by the sea. The murre also use the ice leads for stopping points in their migration and of course, need the open water near the base of their nesting cliffs. An oil spill here would completely wipe out this colony which utilizes an area of only some 200 yards. They are in a critical position because there is an undiked DEW line fuel cache located at the base of the same point.

In crossing the delta, the proponents have chosen some of the prime waterfowl habitats. The proposed line crosses Moore Channel Flats, the area of Coal Mine Lake and Moore Channel itself. It crosses Shallow Bay to the Ellice Island area which is one of the more concentrated areas for staging geese and also very important for nesting swans and ducks. A compressor station is planned in the middle of this area.

Studies performed at the original Taglu discovery site at the boundary of the Kendall Island bird sanctuary found that noise levels frequently exceeded 100 decibels. There were also frequent helicopter arrivals and departures. Approximately 50% of the birds nesting in the area were sufficiently disturbed to move away.

From studies conducted at Anderson River and Kendall Island bird sanctuaries, it has been shown that flying geese as opposed to moulting geese will move when they are disturbed by noise of equipment and by helicopter and aircraft. At varying times during the year some will disperse a distance of up to five miles from the source of the disturbance. Barry suggested

an area of five to ten miles depending on how well the aircraft are controlled around the compressor station site, will not be used by any staging geese. Anywhere from 200-to 500,000 geese, especially snow geese can be found in that area during the latter part of August and through the month of September, and in some years into October.

Of particular concern is the compressor station and pumping station that have been proposed in the middle of the Delta. This area is one of the important fall staging areas for snow geese in particular, but also brant and white-fronted geese occur around that area. On the south side around the shore of Shoalwater Bay, from Tent Island to Blow River, this is probably the densest swan nesting area, with the exception perhaps of parts of the area around Swan Channel, which is not too far from the Taglu drill site. Both of these areas are very sensitive from the noise disturbance standpoint.

Along the coastal lagoons of the shores of the Beaufort Sea, a group of waterfowl, scoters, scaup and old squaws gather to moult. They arrive in the coastal lagoons in the middle of July and are flightless for a period from the 15 July to almost the end of August. Around the Tuk peninsula approximately 600,000 of these ducks are flightless along the various lagoons and barrier beaches. The Tuk peninsula is not used for moulting every year - some years there are very large numbers occurring in northern Alaska. Any oil spill that has washed ashore or over the barrier beaches and into the lagoons, would cause very serious damage to this particular population of water fowl.

It has been suggested that as many as 600,000 birds may use these barrier beaches for moulting. An oil spill near McKinley Bay or the large barrier beaches around Toker Point, Warren Point and Nunaluk Pit near Herschel Island would kill large concentrations of birds amounting to whole flocks. The lagoons behind these barrier beaches are extremely important for invertebrates and fish rearing as well as serving as a food source for some of the higher species. (122,18571-2)

Exposure of a bird to oil is almost always lethal; a spot of oil the size of a quarter will chill the bird sufficiently to cause death. (122,18572) The recovery rate of ducks exposed to oil and cleaned up is almost zero. Even in warmer climates where spills have occurred such as Santa Barbara in California attempts to clean and rehabilitate birds have been unsuccessful, virtually all the birds dying within one or two weeks. This problem is compounded in the Arctic with its difficult logistics and potentially bad ice conditions. If an oil spill were present during the migration period, the continual turnover of birds would mean a very high mortality rate. In Barry's opinion the proponents do not have satisfactory techniques for

quick oil clean up or disposal. (121,18450-51)

An oil spill on an open water area could involve mortalities as high as ten percent for some bird species such as king eider. A residue of oil left on land that destroyed vegetation could prevent nesting success in an area for several years. In such a situation the bird population would be slow to recover. With respect to snow geese there is a threshold number of birds required to begin a colony. Once established such a colony tends to remain in a particular location; thus if the vegetation and habitat of a nesting area were destroyed, the snow goose colony would also be eliminated. (122,18657-8)

Various means have been suggested for discouraging birds from landing in areas where there has been an oil spill as an immediate temporary measure. One possibility would be to attempt to scare birds off with automatic exploders. This method likely would have limited success with species such as eider ducks which are seldom hunted. A second approach would be to coat the spill with some substance such as a white foam which would resemble snow or ice and therefore would be unattractive to birds desiring to land. In Barry's opinion the use of dispersants would not be helpful. (122,18657-8)

The cumulative effect of a number of small leaks and spills from an oil pipeline would cause persistent degradation of waterfowl habitat. Over a long period of time this could be as destructive as a major oil spill. (122,18594)

RECOMMENDATIONS

1. A gas pipeline and related facilities should not be constructed anywhere in the Mackenzie Delta area in view of its extreme sensitivity and importance as a major nesting and staging location for migratory birds. (Barry - 121,18438-41)
2. Further studies of marine avifauna of the Beaufort Sea should be conducted before more offshore drilling activity is allowed in the Beaufort Sea. (Barry - 121,18439-40)
3. Further studies of techniques for preventing migratory bird loss due to oil spills and improved contingency plans to deal with such an eventuality are necessary before further offshore drilling activity is allowed. (Barry - 121,18452-3)
4. Drilling and construction activities should be avoided at times and places where concentrations of migratory birds can be expected to occur. (Barry - 121,18452-3)

5. Construction should be carried out in winter to avoid conflict with bird nesting and migration. (Barry - 121,18581)
6. The Taglu gas processing plant and the proposed Shell Oil plant should be located in less sensitive areas such as Tununik or Richards Island. (Barry - 18461)

WATERFOWL(Particularly Snow Geese)

As admitted by consultants to the pipeline companies and others, prediction of the long-term impacts of a gas pipeline and other developments would be difficult. (Gunn - 93,14142, for example). However, there is no doubt that the area proposed to be traversed by the Arctic Gas pipeline involves some of the most important waterfowl habitat in North America.

Examining the Arctic Gas Prime route from Prudhoe Bay to the Mackenzie Delta, Arctic Gas ornithological consultants identified five areas considered to be particularly sensitive at certain times of the year. These include:

- (i) The Beaufort Sea coast, including bays, spits, lagoons and barrier islands used by a large number of migratory, breeding and moulting waterfowl, other water birds and shore birds, between May and October.
- (ii) The wet sedge tundra extending east and south from Prudhoe Bay for a distance of about 50 miles.
- (iii) Willow thickets bordering northward-flowing rivers on the north slope from Prudhoe Bay to the Mackenzie Delta; used as wintering areas by ptarmigan from November to April.
- (iv) Major portions of the north slope eastward from the Canning River to the Mackenzie Delta; used by snow geese from mid-August until late September and occasionally until mid-October.
- (v) Certain steep valley slopes and promontories along the foothills of the British Mountains from the Alaskan border to the Mackenzie Delta; used as nesting sites by gyrfalcons (March to July) and other raptors from May to August. (Gunn - 89,13423-25).

Since, according to the Arctic Gas consultants, the possibility of prolonged environmental damage to the Beaufort Sea coast cannot be entirely discounted, they have stated a distinct preference for the Interior route with its more limited hazards. (Gunn - 89,13428-31). While recommending that the Old Crow Flats be excluded from pipeline construction (Gunn - 93,14195-96), the Arctic Gas consultants confirmed their preference for the

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Interior route over the Arctic Gas proposed Prime route (Gunn - 93,14162). Since the Old Crow Flats area supports between 70,000 to 170,000 nesting waterfowl, including the rare Tule goose, it is an important area deserving of special protection along the Interior route (Gunn - 89,13423-25; McTaggart-Cowan - 47,6182-83 and 6193). Of equal, if not greater importance to waterfowl in North America is the Mackenzie Delta. The whole of the Mackenzie Delta is ornithologically sensitive.

Both the Arctic Gas original Prime route and the amended Prime route with the Cross Delta alternative have potentially serious consequences for birds in the Mackenzie Delta. However, the Cross Delta route has an even greater potential for damage and, as the Arctic Gas consultant, Dr. Gunn, stated, there are "serious reservations about the Cross Delta route." (Gunn - 89,13434).

The Mackenzie River valley area also has great significance, though the sensitive areas are more restricted and made up chiefly of two types, those involving raptor nest sites and those involving staging and nesting sites for waterfowl.

The islands in the Mackenzie River provide food for migrating ducks, geese and swans and afford some protection from predators. Physical alteration of these islands, especially borrowing or any activity altering river flow that washes river silt from the islands, could have a detrimental effect on the populations. (E.P.B. Interim Report No. 3, p. 17-18; McTaggart-Cowan - 47,6189).

The Fairbanks Corridor has the advantage that it misses the areas that are of great importance to waterfowl and other birds in the northwestern part of Arctic North America (Gunn - 96,14700). The Fairbanks route does cross areas that are of importance, but of secondary importance compared to the areas it avoids.

POTENTIAL CONFLICTS

The potential for conflict or impact on waterfowl of proposed construction of a pipeline covers a wide range of activities. As with birds generally, the greatest problems are those associated with increased access and human activity. "The greatest single problem to confront bird populations and perhaps wildlife populations of the Arctic is uncontrolled access by people" and this problem must be assessed and controls set up before construction is started to ensure that access is limited and sensitive areas avoided. (93,14186). The direction and

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type of barge traffic must be monitored and controlled to protect nesting sites and the location of wharves and stockpile sites closely monitored. Aircraft activity over ornithologically sensitive areas must be controlled as to minimum levels and, of great importance, to control frequency of flights, for spacing rather than altitude is the key to minimizing aircraft disturbance. (Gunn - 89,13429-36 and 96,614704). Restricted flight paths, particularly over the islands in the Delta and High Arctic must be developed (Gunn - 97,14797-99).

Strict control of oil and other toxic materials must be maintained in transit and storage since even a small oil stain on a bird may cause it to lose its life because of loss of the insulative power of the feathers. Birds that are moulting cannot fly away, and become trapped in oily water. Dispersants for oil slicks cannot be used because such treatment causes the feathers to lose their repellancy and birds have not survived de-oiling experiments (98,14886-87).

The use of water for hydrostatic testing or other purposes must be studied in advance to determine the effect of draw down and turbidity. Gravel mining in active channels could mean that certain nesting, feeding or loafing areas for birds may be damaged or destroyed, and there might be downstream effects if it were done in the summertime (Gunn - 98,14895). The impact of active flood plain gravel sources on the Yukon coast is at a relatively preliminary stage and more attention will have to be given to that as one moves towards final design and the final selection of borrow pit locations (Gunn - 98,17896-97).

The protection of the snow goose must be regarded as a particular priority, not only for the fact that it makes extensive and important use of the area but because of its significance to the native people. Disruptions in the cycle of snow geese can be critical since it is controlled by a very strict timeframe and the leeway time is quite narrow. The strength of the bird, because of the distances it must fly, is of fundamental consideration in its ability to survive (Gunn - 97,14843-46). There is likely to be conflict with the activities of staging snow geese and other migrants in late summer and early autumn on the Yukon coastal plain (Gunn - 98,14895) and because many of these conflicts may be unavoidable, consideration of the snow goose population is of particular importance when examining the advisability of the Arctic Gas Prime route.

In general, there are three principal methods of avoiding or mitigating impacts on the ornithologically sensitive areas during the construction and operation of a gas pipeline. One is through

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design and control of methodology. The second is through selective timing, particularly through the various phases of construction. The third is through spatial adjustment of the routing, the supporting facilities and the associated activities. (Gunn - 89,13426). Because most bird activities and distributions are highly seasonal, selective timing is usually the most practical approach to accommodation, and basically this means recommending that as much of the activity as possible be undertaken during the winter months when most of the birds are absent from the region. Of the remaining activities that must be carried on during the summer months, many are of the type that could have detrimental effects on bird populations of certain sensitive species and in certain sensitive locations of major importance to birds. As a means of avoidance or mitigation there is left only spatial adjustments in the routing or location of facilities or in operational techniques such as the control of aircraft flight plans. These adjustments could range all the way from selection of one alternative routing over another, through minor adjustments in location of facilities or in operational techniques such as the control of aircraft flight plans, frequency of aircraft flights and ship movements. In the view of the Arctic Gas ornithological consultants, human presence is one of the most serious causes of disturbance to birds and one to which some birds will accommodate very, very slowly, if at all. From May through October, especially on the tundra with its high visibility, human presence must be as inconspicuous and as infrequent as possible. (Gunn - 89,13426-29).

RECOMMENDATIONS

1. Transportation routes should detour around such critical areas as the Old Crow Flats, which must be off-limits to anyone except the native people. Also off-limits should be the critical areas of such sites as Phillips Bay, Hershel Island, Nunaluk Spit and Clarence Lagoon. (Arctic Gas BRS Vol. 14, p.154)
2. Even if the Arctic Gas Prime route were to be ordered, the Cross Delta alternative must be rejected because of the potential danger to this critical area. Any crossing of the Mackenzie should be moved as far south as possible. (89,13419; McTaggart-Cowan - 47,6186)

RECOMMENDATIONS

3. The very braided sections of the Mackenzie Delta, the innumerable channels and lakes, particularly in the wooded part of the Delta, should be avoided because they are important breeding grounds for ducks. (Banfield - 94,14212)
4. In the event that there is an order for a pipeline to be built along the Yukon north slope then the following areas must be avoided:
 - (i) At Komakuk, all boat traffic should avoid Ptarmigan Bay. (93,14157)
 - (ii) At Shingle Point, all boat traffic must stay well clear of Escape Reef. (93,14158)
 - (iii) Compressor Station CA-05 at the Malcolm Delta and its associated facilities should be moved as it is within the Malcolm goose concentration area. (Gunn - 94,14221; and 98,14872)
 - (iv) Compressor Station CA-06 at the west side of Shingle Point and associated facilities or borrow pits should be moved as it has been sited in the Crow-Phillips goose concentration area and is also in conflict with a cluster of rare and endangered raptor nest sites located within five miles. (Gunn - 94,14222-23)
 - (v) Where possible, compressor stations on the north slope should be re-located and staging or stockpile areas be moved to areas used as part of the DEW line as this is an area that has been previously disturbed. (Gunn - 98,4874-75)
5. In the event that there is an order for a pipeline to be built along the Yukon north slope, or in the vicinity of the Mackenzie Delta, then the following protective measures should be taken:
 - (i) Compressor stations on the north slope and Mackenzie Delta locations in the area frequented by geese and swans should install special equipment to reduce the noise to a maximum level of 50 db. on the A scale at a distance of 1000 feet. (Gunn - 89,13426-29)

RECOMMENDATIONS

- (ii) Consideration be given to re-locating compressor stations at DEW line stations, taking into account the location of these sites and their impact, including any expansions because of looping.

(Hemstock -
98,14882-84;
Gunn -
98,14874)
- (iii) Aircraft traffic, except to established air terminals over the Yukon coastal plain shall be prohibited in the period between 15 August and 15 October. Emergency traffic over this area during this period shall be restricted to IFR flight and such flights shall be carried out at a minimum altitude of 5000 feet.

(Templeton -
97,14800)
- (iv) Ground parties should be prohibited from landing on Kendall Island and from some of the offshore nesting grounds along the Yukon coast during the nesting season from 15 May to 1 August.

(McTaggart-Cowan
47,6182)
- (v) Where snow geese have been diverted from the north slope because of construction activity and are likely to encounter construction across the Delta, construction must be closed down. This is the assumption used by the Arctic Gas consultants in their evidence and assessment of impact.

(Gunn -
93,14173-74;
Banfield -
95,14431)
- (vi) All staging and stockpile sites along the north coast should be self-contained so as to not require regular aircraft supply. People and equipment should be brought in in the summer, by ship. Where this is not possible, strict control of aircraft flight paths, frequency and minimum elevation must be enforced.

(93,14158;
Gunn -
93,14159)
- (vii) Summer activities must be curtailed over pre-migratory staging areas between 15 August and 30 September with necessary overflights avoiding areas of heavy snow goose concentration.

(97,14800)
- (viii) Spits and offshore shallow islands along the Yukon coast are not to be regarded as potential sources of gravel without the most careful study of where and how any such gravel is to be removed.

(McTaggart-Cowan
47,6179-80)

RECOMMENDATIONS

6. Other measures recommended for waterfowl protection along all potential pipeline routes in the Yukon and Mackenzie Valley region are:

- (i) Except as varied below, the recommendations found in Section 6 of the Environmental Impact Assessment of the Environment Protection Board, Volume IV, should be implemented and enforced.
- (ii) All aircraft overflights of ornithologically sensitive areas be at a minimum altitude of 2500 feet. (Gunn - 96,14703)
- (iii) Within a two-mile limit of all critical areas a scheme must be established with the Ministry of Transport officials to govern overflights within restricted corridors. Overflights of islands important to waterfowl must be avoided during the critical spring migration period from open water to 31 May. (Gunn - 97,14797-98; McTaggart-Co 47,6177-78)
- (iv) Construction and other activities north of the Arctic Circle should be curtailed from May to September. Especially critical are the nesting months of June and July along both proposed Arctic Gas routes, and on the north slope from mid-August to mid-September when snow geese are grazing preparatory to migration. (Arctic Gas Vo. 4, p. 15)
- (v) "Buzzing" of birds and other wildlife for photographic or any other purposes should be prohibited. (Arctic Gas Vo. 14, p. 1)
- (vi) The route selected should run as much as possible through large, homogeneous blocks of habitat. Where the crossing of transitional zones is unavoidable, such crossings should be minimal, (e.g. crossing a stream at right angles rather than following its course). (Arctic Gas Vol. 14, p. 1)
- (vii) Open water, marshy areas and other soft ground should be avoided. (Arctic Gas Vol. 14, p. 1)
- (viii) Flights must be curtailed as to minimum altitude and frequency over the pre-migratory areas between 15 August and 30 September and all necessary overflights during this period should be routed to avoid areas of heavy snow geese concentrations. (41,5354-59)

RECOMMENDATIONS

- (ix) Flight corridors be established in all critical areas including the area north of a line joining Aklavik and Sitidgi Lake, Old Crow Flats, and other critical areas.

(McTaggart-Cowan-47,6177-78 and 6182-83; Gunn - 89, 13414-15)
- (x) Where possible, fixed wing aircraft be used in preference to helicopters for necessary flights.

(Gunn - 89,13414-15)
- (xi) Even flights at the minimum altitude will cause disturbance of waterfowl unless properly spaced. Flight frequency should be kept at a minimum and to no greater than .5 flights per hour. During times of potentially serious impact, such as during the period when juvenile geese are in the area, the flight frequency be reduced to .25 flights per hour.

(Gunn - 89,13429-30 and 13436)
- (xii) Because of the sensitivity of geese to aircraft disturbance, flight should be curtailed over the pre-migratory staging areas between 15 August and 30 September and necessary overflights during this time should avoid areas of heavy snow goose concentration.

(Arctic Gas BRS Vol. 10, p. 277)
- (xiii) In all areas of significance to birds used for stockpiling or handling of toxic chemicals or fuels, a boom be placed around the area and wharfing and docking facilities as well as fuel handling techniques be devised so as to minimize the danger of a spill into water.

(Finney - 100,15198)
- (xiv) Where fuel or toxic chemicals are to be handled the most fail-safe procedures should be promoted and enforced, containment and clean-up facilities and equipment should be readily available and spill and prevention clean-up personnel should receive the necessary special training.

(McTaggart-Cowan-47,6188-89)
- (xv) Location of major fixed installations and borrow pits should be made so that their impact on rare land or water birds is minimized. Withdrawal of granular material from critical areas should be prohibited.

(McTaggart-Cowan-47,6189-90)

RECOMMENDATIONS

- (xvi) There should be established and enforced a strict code of behavior during construction and operation including control of firearms and restriction on hunting. (McTaggart-Cov 47,6189-90 and 6192; Gunn - 89,13426-29)
- (xvii) Barge traffic in late summer must be regulated to avoid disturbance of moulting ducks. (47,6192)
- (xviii) Rivers significant to stickleback populations must be given priority since these fish are a prime source of food for loons. (85A, 12752)
- (xix) Because of the highly seasonal nature of bird migrations and the serious consequences of disruption, as much activity as possible be undertaken during the winter months when most of the birds are absent from the region. (Gunn - 89,13426-29)
- (xx) Contingency plans must be finalized well in advance of construction so that strict stipulations concerning pipeline repairs in nesting or staging areas can be clearly set out. (41,5354-59)
- (xxi) Contingency plans and careful procedures for storage and transportation of fuels and other fluids must be formulated. The chief mitigating measure is to contain the oil spill within as small an area as possible. (47,6186; 98,14886)
- (xxii) Chemical dispersants should not be used to control or regulate oil slicks in areas frequented by birds. (98,14886-87)
- (xxiii) In ponds used by waterfowl, the weeds and wildlife should continue to grow to provide a source of food and any draw down of water must not destroy that balance. (Gunn - 98,14889)
- (xxiv) The impact associated with increased access by way of hunting or birdwatching on foot or access by other human activity should be closely monitored. (Gunn - 98,14914)
- (xxv) Snow geese must be monitored and snow geese harvest must be regulated more carefully to ensure a minimum number of birds to protect and maintain a viable population. (Hemstock - 99,15049; Gunn - 98,14880)

RECOMMENDATIONS

- (xxvi) Restoration measures, including re-vegetation and slope stabilization should be applied to ensure that the long-term impacts on the local habitats are minimized. (Bouckhout - 99,15110-11)
- (xxvii) At the Mills Lake and Beaver Lake area the proposed ferry operation be abandoned because of the danger to the large number of birds in the area. (Finney - 100,15198-99)
- (xxviii) The impact of barging operations on waterfowl should be monitored and regulations prepared, particularly for the period during the spring and fall migration. (100,15398)
- (xxix) A strict enforcement regime should be implemented to ensure that pilots, bulldozer operators, fuel barge captains and other personnel carry out the recommendations and requirements laid down. (Gunn - 97,1404-05)
- (xxx) Once requirements are prepared they should be gathered and put in printed form that can be readily available to every contractor and sub-contractor and a training and educational programme be established for people on the site and at the home office to ensure these protective measures are understood and enforced. (Gunn - 97,14805)

RECOMMENDATIONS

7. Some additional waterfowl studies are recommended for completion before final design is approved for any pipeline routes in the Yukon or Mackenzie Valley, including:

- (i) Because of the potential serious consequences to significant ornithological areas on the north slope of the Yukon and the Mackenzie Delta, a critical examination of alternative routes should be immediately undertaken with particular emphasis being given to an examination of the Fairbanks Corridor and its extension through the southern Yukon.
- (ii) Further studies should be carried out to ascertain the degree of attraction of snow geese to any newly-seeded right-of-way. (82,12151-52; 90,13599-601)
- (iii) Further studies should be carried out to determine the combined effects on birds of human presence and compressor noise and otherwise attempt to simulate the combined effect of construction activity. (93,14148)
- (iv) There is a need to define utilization of snow geese by native people as the current data lack specificity with respect to exactly how many birds are killed and where they were killed. (Finney - 100,15399)
- (v) Studies should be conducted to determine lateral distance disturbance thresholds, possible accommodation by geese to disturbance, possible cumulative and long-term effects of disturbance to geese and reactions of geese to fixed-wing and other types of aircraft. (Arctic Gas Vol. 10)

RARE AND ENDANGERED SPECIES (BIRDS).

The protection and preservation of rare and endangered species is one of the most strident public concerns having, as it does, philosophical and moral implications as well as profound biological ones. The question as to whether or not we, as Canadians, have a trust and responsibility to mankind to maintain vanishing species of wildlife is one that all Canadians must consider. (Novakowski - 102,15633).

A species is considered rare and endangered if its numbers are limited and it is either subject to disturbance very easily or if its habitat is threatened. (Gunn - 93,14169-71). This classification of rare and endangered species is further complicated by the fact that there may be sub-species or sub-populations within a particular species so that while the species as a whole may not be threatened, a distinct gene pool within that species may be threatened.

The rare and endangered bird species may be as well known as the whooping crane, peregrine falcon or gyr falcon or as unknown as the Hudsonian godwit, the buff-breasted sandpiper or the Eskimo curlew. However, each one of these birds is a rare and endangered species and each comes within potential conflict with pipeline activities.

The bird species of most concern to ornithologists because of the proposed pipeline activity is the peregrine falcon. Except for some falcons found along the coast of British Columbia and Alaska, over half of the North American population of peregrine falcons nests in areas proposed to be traversed by the proposed pipelines. Peregrine falcons which are known to exist along the Yukon River near the Canadian border represent a vital stock of this rare species. (McTaggart-Cowan - 47,6186; 54,7491). In addition, the Canning River valley, along the proposed Interior route of Arctic Gas, contains important habitat (15,1724), as do areas in the British Mountains, in the canyon near Fort Good Hope, and adjacent to Campbell Lake.

There are two sub-species of peregrine falcon referable to North America and a decreasing population trend has been recorded for both sub-species. Some of this is undoubtedly due to the fact of pollution in their southern wintering area, a matter beyond our direct control, but undoubtedly much of the decline can be attributed to increasing disturbance in the north. The key to the survival of the peregrine

falcon is the maintenance of their breeding habitat in the north and the protection of the peregrine falcon must be regarded as inviolate and the subject of the strongest and most strictly enforced regulations with respect to pipeline routing and construction activities. (Novakowski - 102,15635 - 37; 54,7491).

One of the greatest potential threats to the peregrine falcon is disruption of its habitat and harassment caused by summer compressor station construction in or around areas of peregrine falcon nesting. Since there are few suitable alternative sites for peregrine falcon nesting (which requires a good ledge for nesting and suitable prey species in the area), such activity holds a potential for serious consequences not just for the loss of a year's hatch because of harassment but because of the possible abandonment of a site completely. For this reason, the location and the timing of compressor station construction must undergo the strongest scrutiny and control. (93,14108-09; Gunn - 93,14107).

In addition to the problems of compressor station construction there is a threat to rare and endangered bird species as a result of the location of borrow pits and the extraction of borrow during critical times (81,12069-70; Hemstock - 83,1242; McTaggart - 47,6190).

From the point of view of the protection of rare and endangered birds the Arctic Gas Prime route and Interior route both create problems for rare and endangered species as they both traverse critical areas in Alaska, the northern Yukon and into the Mackenzie Delta (15,1724; McTaggart - 47,6189; 95,14409; McTaggart - 107,16296; 89,13431; Gunn - 98,1486).

RECOMMENDATIONS

1. A national policy should be developed and stated by the responsible governments in Canada indicating a policy position that endangered species and their habitats will be given absolute protection until such a time as the species has recovered and is considered to be out of danger of extinction. Until such a situation arises there will be stringent controls and enforcements and entry for only the most limited purposes. (Novakowski - 102,15655-58)

2. The protection of endangered species in the Northwest Territories and the Yukon Territory, beyond the existing regulatory measures relating to the protection of the species and its habitat and the control of exportation, should be transferred to a federal-territorial joint responsibility using the Canada Wildlife Act as a means of protecting the species and its habitat. (Novakowski - 102,15655-58)

3. Regulations should be enacted for enforcement by the joint federal-territorial agency which would permit entry into a rare and endangered species habitat only by permit and only for the limited purposes stated in the permit. (Novakowski - 102,15655-58)

4. Habitats significant to rare and endangered species should be set aside as specific national wildlife areas or as part of IBP sites. The Canadian land use inventory process could be used in the north to assist in the planning process and for the identification of areas essential for the survival of species such as the whooping crane, peregrine falcon, gyr falcon or other rare and endangered species. Once identified the preservation of these areas should be held as the best and only use of the land to ensure its preservation. (Novakowski - 102,15659; McTaggart - 108,16567)

5. The presence of rare and endangered bird species along parts of the proposed pipeline routes on the north slope of the Yukon is one of several reasons why the Canadian Arctic Resources Committee urges that there be no pipeline route on the Yukon north slope. If it is ordered that a pipeline be built along the Yukon north slope the following route considerations are recommended:
 - (i) Arctic Gas compressor station No. CA-06 west of Shingle Point plus associated facilities and borrow pits have been sited in the Crow-Phillips goose concentration area and are also in direct conflict with rare or endangered raptor nest sites and must be moved. (Gunn- 94,14222-23)

- (ii) Arctic Gas compressor station No. CA-05 (Gunn - 94,14221)
at the Malcolm Delta plus the associated facilities and borrow pits have been sited within the Malcolm Delta goose concentration area and are also in direct conflict with a small cluster of rare and endangered raptor nest sites and these facilities must be moved.
- (iii) Seven peregrine falcon nesting sites (95,14409)
have been located within three miles of the proposed Arctic Gas Cross Delta route and one of these nest sites is within three miles of a compressor station and between one and two miles from a compressor station airstrip. The location of the Cross Delta route must therefore be re-examined with the view of rerouting in the areas coming into close contact with peregrine falcon nesting sites.
6. Proposed pipeline routes in the area of the Norman Range in particular must be re-examined and if possible moved to avoid known peregrine falcon nesting areas. This involves both the Arctic Gas and the Foothills pipeline route. In addition the Foothills line east of Holmes Creek may require realignment once the exact nesting site of peregrine falcons noted in the area has been determined. (Gunn - 89,13428; Bouckhaut - 60,8509; 93,14106 - 07; Finney - 99,15126; 100,15328 - 30; Gunn - 93,14188 - 96)
7. Arctic Gas compressor station sites Nos. CA-09, M-9 and M-11 all located in the Norman Range must be re-examined and relocated. (3,14106-07)
8. The Arctic Gas route in the Campbell Hills area may also require relocation or restriction of construction activity to protect peregrine falcon nesting sites. The Campbell Hills bedrock area should not be used as a gravel source since it is a nesting site for peregrine falcons. (81,12069-70)
9. In all circumstances, and in particular the circumstances involving the facilities and route sections noted above, the pipeline applicant must conduct a comprehensive and detailed (McTaggart - 47,6185; Gunn - 98,14868-69)

study to determine nesting sites for peregrine falcons, gyr falcons, whooping cranes and other rare and endangered species far in advance of determining facilities' location and pipeline routing. Where possible, alternate sites or locations are to be adopted or strict mitigative measures enforced.

10. Fixed facilities or installations such as pumping stations, compressor stations or work camps should be located at least five miles from known nesting sites for peregrine falcon or any other rare endangered species. Borrow pits and haul roads should similarly be placed to prevent impact on rare birds. (McTaggart - 47,6185 and 6190; Hemstock - 83,1242)
11. Pipeline routing should be established so that the pipeline right-of-way is at least two and one half miles away from the traditional nesting sites of peregrine falcons, gyr falcons, whooping crane or other rare bird species. (Gunn - 93,14107; McTaggart - 47,6185)
12. In those circumstances where it is impossible to move the location of compressor stations or other fixed facilities, construction of these facilities must take place in winter rather than in summer, which is the normal procedure. The protection of the rare and endangered species during the critical summer period must be viewed as a high priority requiring strict compliance. (Gunn - 93,14107)
13. During the sensitive season from the beginning of May until mid-September peregrine falcons must be protected from harassment not only from industrial or construction activity but from surveys of nesting sites and any other form of harassment. (Gunn - 93,14101-02)
14. Normal repair work should be carried out in such a manner that the least possible work is done between 15 May and 15 August, critical periods for the bird species. (Gunn - 98,14908)
15. There should be environmental inspectors in attendance at any repair or maintenance work carried out in and around areas with rare and endangered species to make on-the-site recommendations in those emergency situations where summer activity is required. (Gunn - 98,14908)

16. As part of the preconstruction monitoring programme the hunting area of the peregrine falcon must be determined as well as its nesting site. In certain sensitive areas a corridor protection of two and one half miles from the pipeline right-of-way may be insufficient depending on the traditional life pattern of the birds concerned and the relationship of the pipeline to the traditional hunting areas. (Gunn - 98,14904)

17. Air traffic routes must be developed in conjunction with the Ministry of Transport to establish flight paths consistent with the protection of rare and endangered species. These flight corridors are to be established within the guideline that they should not come within two miles of a nesting site, should be at right angles to the Mackenzie River and should not go parallel to the Mackenzie River at any distance less than three miles and should not involve overflight of islands in the Mackenzie. (Gunn - 97,14798; 97,14796-98; McTaggart - 47,6185, 97,14799)

18. In particular, aircraft corridors should avoid aircraft flights over the islands in Mackenzie River between Camsell Bend and Inuvik during the critical months of May and June. (97,14796-98)

19. On the basis of studies conducted by consultants to Arctic Gas there should be established a minimum ceiling of not less than two thousand feet for any flights in or around nesting sites for falcon or other rare and endangered species. This recommendation has been accepted by Arctic Gas for flights over ornithologically sensitive areas. (Gunn - 93,14120; 89,13419-20 McTaggart - 47,6185)

20. In those emergency situations where surveillance or maintenance flights at less than two thousand feet are required in areas known to be sensitive or a critical habitat to rare and endangered species, flights at such lower level should only be allowed upon the approval of the pipeline authority and then only on an emergency basis and under strict supervision and control.

21. Peregrine falcons are also threatened by the use of pesticides and the hunting of falcons for trophy or for falconry. Human interaction by pipeline employees with falcons must be strictly prohibited. (Novakowski - 102,15636-37)

22. Because falcon nest sites are subject to nest robbery to provide birds for falconry, the location of peregrine falcon nest sites, once determined, should not be publicly announced or recorded on maps that will be made public. The pipeline authority supervising construction should be notified of their locations and the pipeline proponents and government should be notified of these locations well in advance of final design in order to accommodate changes in compressor station location and route selection. (47,6185)
23. The increased access and importation of a great number of personnel who will undoubtedly have access to aircraft and other means of transport which might potentially harass wildlife means that special game management plans and protection techniques are required to protect rare and endangered species habitat and in particular nesting sites. It is the responsibility of the proponent of schemes creating this access and bringing in the personnel to develop lands, enforce and pay for the cost of protecting rare species. (McTaggart - 109,16617-20)
24. In the event that development inadvertently intrudes into an area set aside as an endangered species habitat, the proponent of that development should be required, as a responsible corporate citizen, to assist in the rehabilitation of that species or its habitat. (Novakowski - 102,15655-58)
25. Further studies should be carried out to determine whether fixed wing aircraft or helicopters should be used for pipeline inspection and maintenance flights depending on which form of flight minimizes disturbance to rare and endangered species. (93,14122)
26. Complete studies must be conducted to determine the nesting sites for peregrine falcons. However, since accidental disturbance of raptors can be as critical as intentional harassment a duplication of studies and surveys must be avoided. Information on nesting sites and other related matters must be pooled by all concerned. In particular, work by the applicants for pipelines, (Gunn -98,14906; Gunn - 93,14102; McTaggart - 47,6185; Finney - 100,15237-39)

the Canadian Wildlife Service and various levels of governments should be an organized and co-ordinated effort.

27. The preservation of the northern Canada nesting areas and an aggressive search for unknown support habitat utilized by the non-breeding individuals is the key to the preservation of the whooping crane and such programmes must be initiated. Upon location of these areas absolute preservation of the wintering and nesting areas must be practised. (Novakowski - 102,15641; 102,15643)
28. As whooping cranes have been sighted along the proposed Foothills alignment between Yellowknife and Pine Point, a particular study of this area must be initiated prior to approval of any pipeline alignment. (100,15369-70)
29. The Eskimo Curlew is virtually extinct and its future depends on finding and protecting its migrating routes and nesting grounds. Observation and monitoring programmes should be initiated and maintained to concentrate on this species prior to and during any construction activity for purposes of identifying these ranges and initiating protective measures. (Novakowski - 102,16338)
30. Besides the preconstruction surveys and monitoring programmes there must be implemented a continued programme following any construction activity designed to monitor and detect changes in rare and endangered bird populations within at least a few miles of the pipeline right-of-way. (Hemstock - 99,15049)

FISH

This inquiry has revealed that although there has been a great deal of fisheries information presented as evidence we cannot at this time claim to have an adequate quantitative impact assessment for the fish and fisheries in the Yukon and Northwest Territories. There is recognized to be insufficient knowledge about the general biology of Arctic fish species, their ecological context, their population dynamics, and site-specific information for the fish species. As well, there has been so much uncertainty and speculation about the alignment, routing, engineering design and construction techniques that it is difficult to predict with certainty the nature or extent of expected disturbance to the aquatic system or the fish stocks, should a pipeline receive approval. Not only can we not predict what will happen with any confidence, we do not have in place adequate mitigative or remedial measures if a degradation of the fish stocks did occur.

The Canadian Arctic Resources Committee supports the position that the natural aquatic resources in the western Arctic have an intrinsic value to all Canadians, a subsistence value to many residents of the Yukon and Northwest Territories especially the native peoples, a commercial value and a recreational value. It is also the position of CARC that the productivity of the aquatic resources must be maintained at least at their present levels.

There have been many suggestions in the evidence as to how to achieve this end and those considered of merit have been included in the following recommendations. It cannot be interpreted that these suggestions will be enough to accomplish the goals in the face of a decision to proceed with a pipeline. Only a continuing vigorous effort before, during and after construction to do the necessary biological research, to apply innovative techniques to fishery problems, and strict enforcement will insure present levels of aquatic productivity. This submission contains both general and specific recommendations that might apply to a pipeline or any large development in the western Arctic.

The recommendations and significant issues pertaining to the protection of fish and the fisheries resource cover a

wide range of concerns and evidence was obtained from a wide range of experts, both private consultants and government fisheries biologists.

Along the routes considered by Arctic Gas and Foothills there are over 20 species of freshwater fish, of which approximately 15 species are of value in subsistence, commercial or sports fisheries. (Northern Yukon Fisheries Studies, 1971-74 (1975) Vol. I; Fish Resources of the Mackenzie River Valley).

Northern fishes are characteristically slow growing. This low rate of growth, coupled with increased age at maturity, can result in long recovery periods for populations if their numbers are severely reduced. (Stein - 103,15730)

Recovery, however slow, is possible only if reduction in fish stocks is not caused by reduction of critical habitats or long-term aquatic productivity, if harvest demands do not increase and if industrial activity in another place or time does not interfere with the normal recovery processes. The implications of a pipeline project on fish resources in the north are a reduction in suitable habitat because of the new demands for water, gravel, sewage and waste treatment, toxic and other chemical spills and pollution brought on by 'development' and because of the new demand for the fish resource itself brought on by increased population in the north and access providing new opportunities for sport and domestic fisheries. (Stein - 103,15742)

To make an adequate impact assessment or pipeline plan, both the general biology of the fish species and river or site-specific information for the fish species present and their dynamics are necessary. Since the Arctic char is in limited abundance and distribution and is of high economic value, (Hayden - 99,15119) it has been more intensively studied while other fish have not received the same attention. Probably more is known about Arctic char and Arctic grayling than any other species within the Mackenzie Valley because of the significance of these fish. (Hayden - 100,15218) The significance of these two species is more recreational than for subsistence or commercial use. The Canadian Arctic Resources Committee wishes to stress that the whitefish species make up the largest part of the domestic catch in the Mackenzie, Porcupine and Yukon north

slope areas, yet the whitefish group are the fish we know least about. In some species the knowledge gaps are greater than in others. More information should be gathered on ciscos and whitefish in the streams of the Mackenzie Valley. (McCart - 91,13914; Stein - 104,15854)

Four factors control the state of the population size; recruits, the births that enter the population, the growth of these animals, their natural deaths and those that are harvested by man, and one must get a measure of these elements to know their turnover and population dynamics. (Wilimovsky - 109,16695-96) However, such information is not available for any but a few Arctic char populations and even then only in a preliminary way.

There are approximately 600 river and stream crossings north of 60° in the Arctic Gas proposal. Arctic Gas indicated they intended to design stream crossings for 150 specific rivers and streams in the Northwest Territories and Yukon. Six of these are major river crossings, the rest smaller rivers and streams that will require site specific designs. Unfortunately, there is a lack of sufficient local knowledge to provide specific proposals to protect water bodies. Classifying streams based on seasonal flow characteristics, water chemistry, benthic and vertebrate populations and so on, does not necessarily lead to site-specific proposals. (McCart - 93,14093).

To protect the fishery resource, research projects have been conducted in an attempt to classify streams according to use made of them by fish (for example, spawning, rearing, overwintering or migrating areas.) (105,16092-95) It must be noted, however that not all important fishery areas which support various campsites and fish sites used by native people up and down the Mackenzie Valley and in the Mackenzie Delta have been identified. In those cases the numbers of fish, or numbers of species of fish may appear unimportant to a biologist but are highly significant to the native people who are relying on those fish (93,14085-86).

Most studies conducted have been based on the assumption that the researchers are dealing with a normal fish

population. Whether the fish populations are in a stable condition, a condition of decline or whether they are regenerating quickly and the population is expanding, was not considered since the studies were not done over a long enough period of time. The stability or dynamics of the fish populations to be impacted warrants study in itself. (104,15861-62)

The Yukon north slope has been the subject of intensive fisheries investigations. Having classified the streams along the north slope into those that are mountain streams, spring fed streams and the tundra streams, the applicant then concentrated on those streams that had a potential for overwintering and fall spawning because of the anticipated winter construction (85,12656). Those streams classified as spring streams are fed by springs, run year round and are a major source of water in streams on the north slope. The tundra or foothills drainages typically run only during the summer and are dry during the course of the winter so that with winter construction a different approach can be utilized since it is dry and frozen to the bottom. (McCart - 93,14094) The Mackenzie Valley would require more categories for its streams than along the north slope (McCart - 93,14094). Open water and aufeis areas were located in government studies and critical habitats discovered. Because Arctic grayling tend to concentrate in groundwater areas and because these areas have been shown to support spawning, rearing and overwintering of Arctic char, they were identified as significant areas. (Steigenberger - 103,15762-3)

Generally "critical areas" are areas used by fish for spawning, rearing, migration or overwintering. Spawning areas are areas which have been selected by fish populations because they do have particular characteristics; water quality; physical characteristics, presence of gravel and flowing water. (McCart - 91,13772)

In terms of numbers, the Firth River is the most significant river discussed on the north slope because it is a key breeding area and overwintering area for Arctic char. (85,12648) Evidence presented at this Inquiry also showed the importance of the fishery on the north slope on such rivers as the Babbage, Firth and Malcolm. (McCart - 90,13762-63) On the Malcolm River there is an overwintering area downstream of the pipeline in a spring area and the area does harbour an overwintering population which is rather vulnerable because they are closely confined within the vicinity of that spring. (McCart - 91,13769-70) Areas selected as being of particular importance relative to fish populations include the mouth of Fish Creek, the Malcolm River, the overwintering area in the Firth River, groundwater in the

Spring and Crow rivers as well as numerous other areas within the watershed which are similarly worthy of consideration. (Steigenberger - 104,15873-74)

In the Mackenzie River drainage system, the mouths of the Horn, Kakisa and Hay rivers and Kakisa, Tathlina and Buffalo lakes support active domestic fisheries; also a number of streams and rivers in this area are utilized for spawning by fish from Great Slave Lake and a grayling sports fishery exists in the outlet of Great Slave Lake. (Hayden - 99,15122)

The identification of critical areas (spawning, rearing, migrating and overwintering) have led to identification of a number of concerns. River crossings involving a berm or other constriction of river flow have raised concerns with respect to increased velocity that would inhibit upstream migration of fish and about the amount of sediments that may be released into a stream thus affecting its suitability as a fish habitat. (Hollingshead - 20,2391-92; 24,281012) In addition, two situations in which serious obstruction to fish passage could arise as a result of pipeline-related activity involve the use of culverts and where berms are used in major river crossings. (McCart - 92,13988) Since many fish, such as salmon, for example, often feed in huge areas but then migrate and return to a very restricted area to spawn, the entire run could be destroyed by destroying a very small area of a stream. (Calef - 106,16214) Another critical factor about obstruction to fish movements is the length of the delay. If a fish is close to full, ripe, spawning condition, a delay of even 24 hours can significantly reduce egg production. (Wilimovsky - 47,6161) There is also the matter of the time of year that the disturbance occurs. After ice break up fish are in a far poorer condition than after they have had a healthy summer of feeding and growing. Therefore, the fish are more sensitive in the spring and after break up construction is likely to have more effect on fish than activities taking place in the late fall. (Wilimovsky - 47,6161) Also the timing of construction or abandonment of stream and river crossings is important because fish populations could be affected differently at different seasons. If spawning sites occur downstream from a construction site, it is important not to perform construction while the eggs are incubating, where mitigative measures are deemed inadequate. Until tolerance levels and acceptable standards are established it is important to avoid construction when major overwintering fish populations could be affected. (Steigenberger - 103,15757)

The importance of identifying and preserving overwintering areas for fish has been emphasized many times. The need to preserve water and oxygen sufficient to permit the fish to overwinter, whether this water is supplied from river flow below the ice or percolation through the aquifer or gravel bed has been recognized as an objective of the geotechnical advisors concerned with overcoming the effect of the frost bulb at river crossings. (CARC - 20,2394; CARC - 22,2626-27) The potential fish overwintering areas which have been suggested by the fish biologists are primarily associated with warm water springs. Although several of the major springs and associated open water leads on the Yukon Coastal Plain have been identified as important fish overwintering areas, (Harlan - 79,11738) the situation where the operation of a buried, chilled gas pipeline could affect the water supply for overwintering fish populations must be identified and planned for well in advance of construction. (Harlan - 79,11738-41)

A related concern is the use of open water areas for water sources, particularly on the north slope. Opportunities for overwintering of stocks of fish are probably the most critical on the Arctic Gas Prime route where overwintering survival is dependent upon sections of unfrozen water in a number of independent systems. The use of any such areas as a water source, therefore, poses a potential problem. (Walker - 103,15748-49)

Areas which have been identified as important for overwintering include groundwater fed streams, the main stream of large rivers, and several smaller streams with adequate winter discharge. Again, open water areas are critical. Three of the groundwater sources documented as major overwintering areas include the Old Crow River headwaters, the open water area of the Fishing Branch River and the Miner River. Other areas associated with groundwater sources that may offer potential overwintering sites are the Brown River and Little Bell River headwaters, the Salmon Fork River headwaters, the Blue Fish River and possibly the Waters River. There have been documented overwintering sites in the mainstream of the Porcupine River and potential sites on the Bell River. (Steigenberger - 103,15769-71).

Even if the river is frozen to the bottom, there is a concern that underneath there may be some water flowing that may be going into areas in which fish are overwintering. It is

important, therefore, that even those rivers be examined in detail. (McCart - 85,12639-48)

Siltation is also regarded as a major environmental concern in aquatic habitats. (McCart - 88A,13383) Although research has identified hundreds of locations in which Arctic char spawn, the issue is to ensure that sedimentation does not take place to such an extent that it detrimentally affects a sensitive stream used for spawning. (McCart - 84,12554 and 85,12634)

Besides the identification of critical areas of concern for the protection of the fisheries resource are activities such as gravel extraction, discharge of methanol, use of toxic chemicals and potential oil spills, channelling, blasting in river beds, timing of construction activities, river-crossing techniques, use of water and water sources, obstruction of fish passage and interruption of sub-surface drainage. One must also consider the appropriate management of the fishery resource and the enforcement of measures designed for fishery protection.

One must also keep in mind that the recommendations and identification of significant issues and potential problems relate exclusively to consideration of a chilled gas, buried pipeline. The consideration of a road, with its numerous culverts and passage over streams and rivers and a hot oil pipeline would obviously raise very different concerns. It would be fair to say that from an aquatic standpoint, an oil pipeline has not been looked at by either the Environment Protection Board, the Arctic Gas consultants or the government researchers. (Wilimovsky - 107,16302-03)

The various considerations involved have had a significant impact on questions of both detailed alignment and route alternatives. Spawning grounds and overwintering areas are probably the fish habitats which would be the most sensitive to the effects of a pipeline. Sediment during or after construction would render them unsuitable for spawning. Therefore, a primary consideration in recommending pipeline routes is desirability of crossing rivers downstream from spawning grounds. (Steigenberger - 103,15757)

All pipeline crossings must plan for and consider the problem of obstruction to fish movement. Fish frequently make small

movements, a few hundred yards to a few miles, for spawning activities, whether in the spring or the fall. Other fish make extensive migrations and still others just move up and down a river system depending on the particular food pattern. (Wilimovsky - 47,6160-61)

The problem of establishing safe silt levels is not well understood. Siltation affects spawning grounds by getting in between the cracks in the rocks and gravel where fish lay their eggs. Silt can also limit food production in nursery areas. A certain amount of natural siltation occurs but the question of what additional level of siltation is acceptable and at what times of year is still not completely understood. Fish spawning beds and nursery areas that have become silted over can be cleaned out but it is an expensive and time-consuming effort and protection can only be guaranteed by ensuring the activity does not occur. (Wilimovsky - 47,6157-59)

In the natural state, gravel affects the lives of fishes in providing a space for spawning and for protection against predators as well as substratum for certain food organisms. It is not just the gravel but its size, spacing, packing and the flow of water through it, as well as silt load, that affects its suitability. When gravel is taken from stream beds where natural replacement is slow, this will undoubtedly have a negative impact on fish egg production and fish food production. (Wilimovsky - 47,6159)

Based on a consideration of the aquatic environment, the Coastal route is to be preferred to the Interior route (Wilimovsky - 107,16302-03; McTaggart-Cowan - 107,16303; Steigenberger - 107,16303-04; Walker - 103,15751-53). Mr. Walker, who is familiar with both the south and the north part of the Yukon, stated, however, a definite preference for the Fairbanks route as compared to either the Prime route or the Coastal Route. (Walker - 103,15751-53) The Interior route is considered fragile in terms of fish. Because there are a large number of species they might be affected by damage caused by a pipeline. (103,15905) The north slope is, however, significant for fish populations and some fish use the coastal lagoons in the area, even though many of these fish are not fished along the coast but rather in the Mackenzie Delta. (Steigenberger - 104,15910) In looking at the various possible routes, a number of important factors stand out. These include the issues of

access by permanent road, availability of water, stock composition and the use of fish as a resource. Road access has a significant bearing on the route assessment because access increases the opportunity for exploitation.

Benthic invertebrates are important to fish populations not only in the streams but especially on the north coast of the Yukon. So with regard to pipeline routing, the coast itself is an important feeding ground for a large number of fish, especially the ones that come out of the Mackenzie to feed in the summer in the pools and lagoons behind the point bars, and so on. It is in these areas that there is potential for damage to invertebrates that the fish depend on for feeding. (McCart - 91,13945-46)

The Mackenzie Delta is particularly important for aquatic life since it is known as a spawning, migration and overwintering area for many species and also because it is an important area of primary aquatic production. Deterioration of water quality in this area could have far reaching adverse effects and the proposed construction of the Cross Delta route has the potential to cause significant impact on the aquatic environment of the Delta area. (Hayden - 99,15120) The Mackenzie Delta, with its multitude of channels, is much more complicated than other areas and it is more difficult to determine the timing of fish migration than the major migratory routes. (Stein - 104,15849; Stein - 105,16053 - 54).

It is known that whitefish, cisco, and inconnu migrate through Shallow Bay. Perhaps more important, it is also the route used by the only two Arctic char populations that we are aware of within the Mackenzie district, those being the Rat and Cache Creek populations. The critical time period for migration in the Delta is June and July and is of concern should there be dredging or other activity in Shallow Bay during that time period. The time of fish migrations vary from year to year but the season can be pinned down fairly accurately as lasting from the end of July at the very earliest to November. This takes into account the returning migrations so that Shallow Bay is literally teeming with aquatic life, moving in both directions, for a period of approximately five months. The entire area of Shallow Bay need not be considered a critical area but as it represents the migration route for a number of fish species there is a critical factor that passage must be assured through the area. (Stein - 104,15897-904)

Probable spawning areas for grayling that are close to the proposed crossing sites on the Prime Route are found in the Firth River, the Crow River, Trail River, Deep Creek, Walking River, Low River and Rapid Creek. (Steigenberger - 103,15773)

Probable spawning areas for grayling and other species close to proposed crossing sites on the Interior route are found on Potato Creek, Surprise Creek, the Old Crow River, Driftwood River, Berry Creek and the Rat River. (Steigenberger - 103,15773)

There is also the possibility of a critical overwintering habitat that is downstream of the proposed crossing of the Prime route, in close proximity to the coast of the Beaufort Sea. One of the small tributaries south of Stokes Point Lagoon indicated a presence of juvenile Arctic char, indicating the fish were isolated in that environment. (Steigenberger - 105,16034)

It is also important to keep in mind that in both the Coastal route and Interior Route winter is a critical time of year when fish are limited in some cases to isolated sources of water (groundwater sources). The fish through evolution have survived and adapted to this type of winter environment. In the case of fall spawners, the overwintering life stages of hatching eggs are at the mercy of both the level and duration of silt introduction. It has been stated that juvenile and adult fish can avoid sediment by displacing themselves at least through spatial distribution. However, the extent of these groundwater sources is not large and displacement would not be possible, thus accentuating the effect of any sedimentation. (Steigenberger - 105,16080-81) The winter survey revealed that the overwintering area for fresh water species, in addition to the groundwater sources, along the coast of the north slope of the Yukon is probably limited to that area of the Beaufort Sea under the influence of the discharge of the Mackenzie River, again a limited area. (Steigenberger - 103,15766-68)

The lower limits of the Old Crow River have been documented as one major pathway to overwintering areas on the Porcupine River. (Steigenberger - 103,15769)

In spite of the extensive research done by private consultants and government, the information gaps and critical areas not yet identified are cause for concern. There is great difficulty in determining specific population estimates for fish, partly due to the fact that there are tremendous numbers

of discrete fish stocks which all migrate up the Mackenzie River and it is difficult to distinguish them in a sampling programme. (Stein - 104,15883-84)

Even assuming that a pipeline can be built with a reasonable standard of protection for fish resources, we are still not able to determine where and when protection measures are required due to the information gaps currently existing. (Stein, Walker, Steigenberger and Millen - 105,16074-75) The witness, Stein, dealing with the Mackenzie River Valley and the witnesses, Walker and Steigenberger, dealing with the north coast of the Yukon, all said they did not have anything like a complete inventory of fish stocks. In their view, a complete inventory along the proposed pipeline route would take two or three years with a properly funded programme and that such a programme should be completed before an appropriate impact assessment can be made and the pipeline then possibly approved. (109,16708-09) Biologists have been able to locate and define a number of nursery areas, spawning areas and overwintering areas but the overall picture is far from complete. (Stein - 104,15850) Additional work should be done on sedimentation, its effects and on toxicity. This work must also be related more specifically to northern species, northern organisms and the northern environment. Given the appropriate level of funding and manpower, we are still talking about something in the neighbourhood of two or three years to complete such studies. (Stein - 104,15867-69) Even on the north slope, which has been the subject of extensive study, there are knowledge gaps.

It is necessary to have data on the swimming performance of the various species that will be of concern in order to draw any conclusions as to their ability to navigate any particular velocity of water at any particular crossing. While one can extrapolate from available data for assumed performances of other species, studies relating to these other species have not been conducted. (McCart - 91,13813-14)

It is often very difficult to get specific spawning information on some fish and the spawning areas of Arctic char are probably easier to identify than most fish species. It is the fall spawning fish, however, that are of the greater concern. One of the major concerns with the fall spawning fish is to ensure that the larger streams and rivers crossed by proposed pipeline routes do not include spawning areas. (Hayden - 100,15287-94)

While it is agreed that emphasis should be on the downstream portion of a river to be crossed by a pipeline, there is also

value in knowing that utilization is being made of the upstream portion. One needs an estimate of the relative number of fish that are spawning up above the proposed crossing in order to provide good protection for those fish when they pass the crossing site. It is also important to have good baseline information on the entire system to take into consideration such factors as change in alignment. (Stein - 105,16049)

From a synoptic survey, one can assess the state of maturity of the fish that would give much information as to whether or not there will potentially be spawning in that river system. If water conditions are favourable, it is possible to obtain an assessment of what are "potential spawning areas", in other words, gravel or substratum that, in the biologist's opinion, appears to be suitable for spawning purposes. Unfortunately, the spawning habits of a large number of fish in the western coastal Beaufort Sea are still poorly known. Also the location and frequency of spawning have not been determined for the Mackenzie River least cisco and little is known about their distribution, breeding or habits. The spawning habits of the Arctic cisco are also poorly understood. Spawning occurs over gravel in fast water sections of streams, however, actual periods and locations of spawning are not known for Arctic cisco in the Mackenzie River. Information on the distribution, movement and feeding habits of fry and juveniles is lacking. It has been speculated that fry are washed downstream to the Mackenzie Delta during the spring floods and several nursery areas have been located in the Delta itself but the complete picture is not understood. Little information is available regarding the spawning habits of the inconnu and of the humpback whitefish in the coastal areas. While it is believed that the mouth of the Arctic Red River and tributaries of the Arctic Red and Peel rivers are spawning areas, not much beyond that is known for certain. There are suspected spawning areas in the upstream tributaries of the Arctic Red, Peel and Mackenzie rivers (inconnu), the tributaries of the Arctic Red, Peel and Mountain rivers (Arctic cisco), lower reaches of the Mackenzie (least cisco), the back eddies of the Mackenzie Delta and Mackenzie River and also the mouth of the Red River (broad whitefish) and the back eddies of the Mackenzie River and Mackenzie Delta (humpback whitefish). However, following spawning, there is spawn incubation, hatching, fry emergence, rearing, feeding and maturity. These different life stages may be carried out in places other than where the fish spawn. (Stein - 104,15852-54 and 15901-02; Walker - 104,15893).

It appears that most of the spawning in the Mackenzie Valley takes place in the tributaries of the Mackenzie rather than the Mackenzie itself. Biologists cannot pinpoint the important spawning areas in the Mackenzie in spite of considerable effort, perhaps because of the turbidity of the water or perhaps because there are none; in any case further investigation is required. (McCart - 93,14070)

There is great difficulty in working with fish in the Peel River. Usually the catch consists mainly of ciscos and it is not really known how big the cisco population is and, secondly, it is not known where they spawn, the distribution of the spawn or the spawning area. (McCart - 91,13903-04)

The location and frequency of spawning activities has not been determined for the least cisco in the Mackenzie River. Fry hatch in the spring but very little is known of their distribution, movements or feeding habits. (McCart - 91,13917-18)

Spawning habits of the Arctic cisco are poorly understood. Sexual development in females approaches completion as early as mid-July and upstream spawning migrations in the Mackenzie River occur from July to September. Spawning occurs over gravel and fast water sections of streams, however, actual periods and locations of spawning are not known for Arctic cisco in the Mackenzie River. Information on the distribution, movements and feeding habits of fry and juveniles is lacking. It has been speculated that fry are washed downstream to the Mackenzie Delta during the spring flood, however, more information is required. (McCart - 91,13919-21)

Little information is available about the spawning habits of inconnu. The young presumably emerge in the spring and may be carried in the spring flood to the lower reaches of rivers or to brackish water. (McCart - 91,13921)

Little information is available about the spawning habits of humpback whitefish in the coastal areas. (McCart - 91,13922-23).

One of the biggest deficiencies is that the winter biology of many species is inadequately known. A mixture of reconnaissance and detailed surveys to locate overwintering areas by doing samples at river mouths in the winter, and hopefully in the Mackenzie itself, to try to locate various whitefish species, the fall spawning fish primarily, is necessary to be confident that winter construction does not conflict with the essential habitat of these fish. (Hayden - 100,15216-18)

As far as the northern part of the Yukon is concerned, many critical overwintering areas have been identified. However, there is still incomplete understanding of the overwintering capabilities of the total biology of the fishes and the state of knowledge of overwintering in that habitat is still at a preliminary state. (Steigenberger - 105,16035-36)

In the Mackenzie Valley, the witness Stein indicated he would like to see winter studies conducted on essentially every tributary that is being crossed. (Stein - 105,16077) There is fairly good data on readily visible overwintering habitats (open water areas) however, the complete inventory of overwintering habitats is not available. (Stein - 104,15869)

RECOMMENDATIONS

Approach and Timing

1. The general approach, in all instances, must be directed towards the protection of the fishery source rather than re-stocking since re-stocking cannot be expected to be a very hopeful approach, especially when one considers that it has taken 75 years of effort to develop salmon re-stocking programmes in more favourable southern climates. The re-stocking approach is one that we should not rely on in the event that a project caused a local population to be decimated. (Walker - 104,15895-96)
2. As much information as possible on the harvest rate should be obtained and a management scheme established. It is necessary to develop an overall plan to ensure the protection of the fishery resource. Such a plan would require an estimate of the potential yield of the entire Mackenzie Valley, a determination of the goals for the Mackenzie Valley aquatic system, be it domestic sport or commercial fishery, and the establishment of an overall long-range plan to manage the system to achieve these goals. This type of research and planning is "environmental insurance". (Wilimovsky - 109,16695-98)
3. A Canada-wide freshwater fish management agency should be created to provide a framework for an overall fish management regime, which the area to be impacted by a gas pipeline would form a part. (Wilimovsky - 109,16700)

4. The approach to environmental protection measures must be to establish mitigative measures to acceptable standards of disturbance in any stream and, secondly, to protect the most sensitive species. Stock composition is important to examine because it may have a strong bearing on rehabilitation opportunities in the event of damage. (McCart - 93,14094-5; 97-100; Walker - 103, 15748-50)
5. Interdisciplinary discussions must be held early on in the planning process between environmental consultants concerned with specific environmental concerns. Dr. Gunn, the ornithologist, advised that he had not actively consulted with Dr. McCart to determine the characteristics in lakes that would govern recommendations to Arctic Gas concerning water removal, for example. Thus, there remains the possibility of conflict between the waterfowl as opposed to fish even in advance of potential conflicts between the environmentalist and engineering consultants. (Gunn - 93,14134-35)
6. The recommendations of biologists would depend on the importance that the biologists have placed on the stream identified. A priority must be established to determine how important that habitat is to fish, followed by specific recommendations as to measures required to protect that habitat. (Steigenberger - 105,16098)
7. Wherever there is a domestic fishing site close to the pipeline alignment, the alignment and all related facilities should be moved as far as possible from that site. (McCart - 103 - 14084)
8. Construction and abandonment operations should be scheduled to avoid interrupting fish migrations, particularly spawning migrations. If construction is allowed to proceed during periods of fish migrations then it is necessary to monitor the passage of fish and to halt the construction if migration is impeded. Construction schedules appropriate for each river crossing should be provided to qualified fisheries personnel for review and approval prior to construction schedules being prepared. (Steigenberger - 103,15757-58; Stein - 103,15720-22)

Toxic Chemicals and Methanol

9. The Canadian Arctic Resources Committee recommends that there be no release of methanol to the environment.
10. Because there are chances of accidental releases of methanol even if its deliberate release were to be prohibited, there should be mitigative measures developed for such accidents. Highest priority should be given to spawning areas because spawning or developing eggs are more sensitive to the effects of methanol than free-living fish. (McCart - 93,14068; McCart - 91,13843)
11. Stockpile sites, wharves and any other facilities for the handling or storage of toxic chemicals are not to be located near fish camps or other areas of local subsistence fishery. Impact on local fisheries must be one of the factors to be considered in final location. Discussion with local inhabitants and the people dependent on the fishery must precede any decision. (Hemstock - 93,14086-88)

Water Sources

12. Water should not be taken out of rivers on the north slope of the Yukon. (McCart - 84,12608)
13. Contingency plans should be prepared indicating other water source locations to be drawn upon in the event that an unexpected water shortage occurs. These auxilliary water sources would only be available under strict supervision and following approval by biologists. (85A,12769-70)
14. Water must not be taken out of a system such as to expose gravels to the air that would have in the past been utilized for spawning or over-wintering. (McCart - 85A,12760-61)
15. In general, where there is a possibility that de-watering an area could result, such as Vermilion Creek downstream, the majority of the water should be withdrawn from the Mackenzie River. (McCart - 85A,12760-61)
16. Particular concern and attention must be given to taking water from streams in winter in areas where there are fall spawning species. (McCart - 85A,12762)

17. All sources of water and quantities required should be known and approved only after consultation with fisheries, biologists and local residents. (38,4854)
18. Water should be taken only from those lakes that have no fish population or which are so deep and have such a large volume of water that withdrawal will only be an insignificant portion of the volume. Water should be taken from no lake which is small in volume or where the natural oxygen level is low. (McCart - 84,12607)
19. Campsite locations are to take into account the fact that water will be used for camp purposes and for waste disposal. Camps should be located far enough away and downstream from significant fish populations and water impact studies, indicating maximum amount of water withdrawal, approved prior to camp location. (Hayden - 100,15216)
20. Water should not be taken from one water body and discharged to another without agreement that acceptable standards will be met with respect to water quality, effects of discharged water and effects on water body from which the water is removed. If water is removed, it should be taken only from areas downstream of spawning and overwintering areas. The amount of water removed should not exceed the minimum winter discharge rate at the spawning or overwintering location. (McCart - 85A,12762-63)
21. Site specific examination of the surface area at the bottom of the stream must be carried out in each instance. This requires examination of the spring streams, an assessment of the distribution of fish and, where fall spawners are involved, looking at the distribution of eggs in the gravel. Water should be withdrawn only to such extent as would not result in the dewatering of any significant portion of the area. This applies where taking water downstream (the preferable method) is impossible. (McCart - 85A,12756-7)
22. In the Mackenzie Valley, water should be withdrawn from the Mackenzie River rather than from the tributaries flowing into the river. Also, the water should be withdrawn downstream and (McCart - 85A,12763-64)

should be withdrawn in such volumes so as not to be a significant part of the total discharge.

23. Water from Vermilion Creek should be taken only downstream from the crossing and in such quantities that would normally not cause damage to the overwintering grayling populations. (McCart - 85A,12745)
24. Water should not be removed from Oscar Creek. (McCart - 85A,12745)
25. Water should not be taken from the River Between Two Mountains. If water is to be taken from the springs in the river this should only be done after a detailed investigation of the impact on fish populations. (McCart - 85A,12745-46)
26. Water from the Rat River should be withdrawn only downstream and in such amounts as will not cause damage to the Arctic char populations in the overwintering areas. (McCart - 85A,12746)

Blasting

27. In rivers with no running water in winter, whether surface or sub-surface, blasting shall take place during the winter months when the crossing is dry. Where blasting is used, mitigative measures must also consider the increased silt loads that occur in spring after winter blasting. (McCart - 96,14688)
28. Blasting in the river bed of the Great Bear River must be done in such a way as to protect the grayling migration and the other fish resources.

Gravel Removal

29. In establishing quotas and inventories for gravel removal there must remain sufficient gravel left to support fish populations that are likely to use the area. For each crossing there must be established a safe quantity of gravel for the continued maintenance of the fisheries resource on a long-term basis. (Steigenberger - 105,16108; Stein - 105,15984; Wilimovsky - 47,6160)

30. Gravel mining operations must be planned in such a way as to avoid sedimentation of spawning grounds and so as to prohibit constriction of a river flow which may cause a velocity barrier to the upstream migration of fish. (McCart - 85,12636)
31. No gravel extraction should occur below the design flood high water level nor closer than 300 feet from the wetted perimeter of streams. (Stein - 105,15987)
32. Gravel should not be removed from the active flood plain of streams, especially in areas where bank erosion is possible. (McCart - 85,12669-70 and 12673; McCa: - 85,12668)
33. No phase of gravel mining operations should commence before the end of August to ensure that the Arctic char have passed through the crossing areas to their overwintering areas downstream of any mining operations. (McCart - 85,12636-37)
34. Mining operations shall not be allowed upstream of any area of significant Arctic char spawning. The possibility of a flash flood or similar occurrence could result in siltation into the spawning area where fall spawning fish would be adversely affected. (McCart - 81,12115-16)
35. Once mining is completed the area is to be levelled to a level which is at or above that of the active channel and then the protective berm breached so that water can move through the area naturally. The gravel mining area must be left in such a state as to avoid ponding at any time of year. (McCart - 79,11707)

Channelling and Impediments to Flow, Culverts

36. No berms shall be placed up against an active channel nor shall channels be used in braided streams to divert flows around working areas. A buffer zone, suitable for the particular circumstances, shall be left between the upper channel and the working area. (McCart - 81,12129-30)
37. No evacuation or construction shall take place in single channel streams, such as bank removal, that would encourage stream migration or diversion of the stream flow. (McCart - 85,12670)

38. Ice bridges shall be cleared to ensure that no debris is left which can interfere with migration or affect stream water quality. (Hayden - 99,15120;Jarv 67,9860; McCart - 93,14066)
39. Ice bridges shall not be constructed using foreign materials such as logs which could then settle into the streams as a result of constant use by heavy construction equipment. (McCart - 93,14067)
40. Removal of ice bridges, including all materials used in their construction, shall take place at such a time as to avoid siltation problems, particularly at a period of low water flow. They shall be removed prior to any real movement of water in the spring. (McCart - 93,14067-68)
41. A possibility still exists that the ice bulb formed around a chilled gas pipeline below the surface of a river may cause an icing and freeze off an aquifer supplying water to overwintering areas for fish upstream of the crossing. The buried mode of construction underneath rivers containing important overwintering areas for fish should not be approved until geotechnical problems associated with maintaining water flow to these overwintering areas have been satisfactorily resolved. If these problems cannot be resolved, a system of crossing these rivers by above-ground construction or other techniques are to be examined. (Adam - 107, 16348-50, 80,11924)
42. If a pipe or culvert is to be used to ensure sub-surface drainage through a frost bulb, such drainage is to be instituted at the same time that the buried pipeline is installed, even though the pipeline will not be chilled until gas comes on-stream. (Clark - 28,3493)
43. The danger exists that snow-harvesting operations will take off the insulating layer of snow over lakes used for overwintering by fish, causing the area to freeze to the bottom, thereby killing off the fish. Research and data must be gathered to ensure these lakes are identified and that no action is taken that would result in severe limitation of essential overwintering habitat. (Jarvis - 66,9822-23)

44. As a general rule, all culverts, berms or other measures interfering with normal river flow and the migration of fish shall be evaluated and constructed in such a manner as to permit continuing fish migration. (McCart - 82,12275; McCart - 92,13988)
45. Where possible, bridges rather than culverts are to be used in stream crossings requiring the passage of fish. Arctic Gas advises only five culverts will be used throughout the length of the pipeline, all south of Travaillant Lake. (McCart - 92,13988; McCart - 93,14065-66)
46. Fish use the natural and uneven stream bottom to aid in their passage upstream. Baffle culverts and elliptical culverts, which sit below the bed of the river and allow the natural substrata to be maintained, each have benefits, yet, as demonstrated at the Ringling River crossing, each must be selected on a site-specific basis depending on the particular habitat required to be protected. (McCart - 92,13988-91)
47. Culverts are to be constructed so as to minimize the potential for a scour. (McCart - 92,13882)
48. Elliptical culverts or various types of other culverts are to be used depending on a particular circumstance so as to ensure they will not collapse, that the velocity created does not prevent movement of fish upstream and otherwise to ensure that culverts do not pose a barrier to fish passage. (McCart - 92,13994-5)
49. In all permanent roads culverts should be made the approximate width of the natural stream, where feasible. (Hayden - 100,15258)
50. In all braided streams a bridge rather than a culvert is to be constructed, where feasible. (Hayden - 100,15258)
51. Culverts must be wide enough and large enough to accommodate maximum flow and to allow fish to move up during the period of maximum flow. (Hayden - 100,15258)
52. Inverts are to be placed at the entrance and exit portion of the culvert which are at or below grade so that materials will accumulate in the culvert, thus decreasing the mean velocity. In those circumstances baffles are not necessary. (Hayden - 100,15259-60)
53. Fish culverts, that is, a culvert placed at a different location to allow better movement of fish in addition to the culvert designed to take the mainstream flow, are to be employed where possible. (Hayden - 100,15260-61)

54. Culverts are to be used at the end of a berm protruding into a flowing stream so as to reduce velocity at the end of the berm which might be a problem to fish migration. (McCart - 90,13743-46)
55. Further research should be done on the Ringling River collapse of the culvert to determine exactly the problems created and engineering recommendations as to how this problem can be avoided in the future. (Millen - 104,15928)
56. The size of culverts used in stream crossings must be varied depending on the flow required and the engineering difficulties to be encountered. Large diameter culverts are to be examined carefully before their employment is to be approved. (Millen - 104,15928-30 Steigenberge 104,15930-31)

Siltation

57. High silt loads are to be prohibited in the vicinity of overwintering or spawning areas, particularly during the winter months when silt loads are normally very, very low. (McCart - 81,12133)
58. Ponding with high silt content waters should be prevented by ensuring materials are not taken from the flood plain below the water table and by filling in all holes or work areas before the protective berm is breached. (McCart - 81,12133-34)
59. Besides the spawning and overwintering areas, domestic fishing sites must similarly be identified as critical areas and protected. Unlike other areas, short-term or seasonal impact or impact that does not destroy fish but merely forces them to avoid an area for a particular period of time could still result in major impact because of the native dependency on that domestic fishery. (93,14082-83)

60. Benthic invertebrate populations are far more sensitive than fish in general and, irrespective of the tolerance level of fish, precautionary measures sufficient to protect benthic invertebrates may be required in specific locations. Locations with important benthic invertebrate populations would be identified and more stringent protective measures enforced in those areas. (McCart - 93,14100)
61. In water courses, such as the Great Bear River, where the berms or other constrictions into the flow are to be constructed, measures to ensure that sedimentation does not result from construction of the berm are to be implemented. This includes, in particular, construction at times of the year where sedimentation is not a serious problem and use of techniques and materials that will reduce sedimentation danger. (McCart - 90,13756)
62. Sedimentation may occur through erosion of the right of way as well as activity within the river flow itself. Such sedimentation may reduce the productivity of the invertebrate food sources that maintain the fry, juvenile and adult life stages of fish populations. While winter months are particularly sensitive because they are normally times of very low sedimentation, this potential danger applies to all year round, particularly when considering the Mackenzie Delta which is utilized at all times of the year. (85,12641)
63. A series of studies should be carried out following completion of the river crossing to determine the effect of siltation on critical habitat and to monitor the rate of habitat recovery. This information should then be utilized in subsequent river crossings. (104,15932-33)
64. Stream gravels may contain the incubating eggs of fall spawning species, including the whitefish, ciscos, inconnu and Arctic char. Along the Mackenzie Valley the location of these critical areas is not known with sufficient precision to determine whether siltation problems created at river crossings may cause difficulties. Identification of these sites and accurate information on potential silt load must be available before a pipeline crossing is approved. (Stein - 103,15809-10)

65. Further research be conducted to provide base-line information on the nature of the siltation, the rate of its oxidation, current flow, particle size and expected time of silt discharge, both in the laboratory and in field controlled experiments, to quantify the expected impact of siltation before approval for a site crossing is granted. (Wilimovsky - 109,16693,94)
66. In areas where there are fall spawners, particularly Arctic char, particular protection is required to ensure that there is not siltation of the spawning areas since in normal circumstances siltation levels at the critical times are very low. (McCart - 81,12115-6)

River Crossings

67. Before a river crossing is approved a complete site-specific study is to be conducted to determine what fish are in the river, the use of the river by various species of fish, whether there is a spawning or overwintering area and whether it was a migration path or a nursery area. Information must be gathered on the method planned for crossing the river, the time the crossing will take, bank and river bottom disturbance. Also, the information on the fish use of the river must be sufficient to allow recommendations to be made as to the appropriate timing of construction and acceptable techniques. Each river should be classified as to its significance and use by fish to ensure that particularly sensitive crossings have more than the usual protection. Once construction techniques have been prepared a determination of the water velocity, extent of siltation and other related impacts must be catalogued and a biological assessment made as to whether such an activity would be acceptable. (Hayden - 100,15285-90)
68. The Great Bear River and the Hare Indian River are important crossings requiring specific and detailed studies and special protection techniques. (Hayden - 100,15292)
69. In considering the impact of river crossings on fish it is important to remember that some rivers may not contain sufficient numbers of fish yet are essential because they supply various fish food organisms to the whole Mackenzie Valley system. (Hayden - 100,15292-94)

Even in those rivers and creeks without significant fish populations, special river crossing techniques are required.

70. Large winter river crossings require particular information and attention. Data as to the flow rates and flow patterns, sediment characteristics, water chemistry, especially dissolved oxygen, and toxic analysis, must be conducted. In summer time, it is necessary to know the eating habits of the different species spawning in the area, identification of all critical habitats and water flow information. (Stein, Steigenberger, Walker - 105,16099-102)

71. For the 400 odd streams that are not going to be studied on a site-specific basis we should have a complete habitat analysis for even these minor stream crossings, in particular, identification of overwintering and spawning areas for fall spawning species. (Stein, Steigenberger, Walker - 105,16099-102)

72. Any site specific assessment must emphasize the crossing point and the area below the crossing point. However, upstream studies should be implemented, the extent to be determined based on the characteristics of the individual stream. (Stein - 105,16051)

73. Any crossing involving installation of a berm must undergo particular study on river velocity to determine the impact on migration. (McCart - 90,13758)

74. On the north slope, particularly on those rivers and streams that freeze to the bottom in winter, special attention must be directed towards open water areas and overwintering areas such as groundwater fed stream sections and the estuaries and lower limits of coastal streams. (Steigenberger - 103,15762)

75. In rivers demonstrated to be sensitive spawning and nursery areas for spring spawning species, such as grayling, no construction should be allowed during the period May until November and a crossing, if required, must be entirely constructed during the winter season. The Hare Indian River and the Donnelly River are two examples of such rivers. (Rowe - C181824; 42,5510-1)
76. In situations where a berm is required throughout the construction season and where it does not cause siltation or interfere with migration, it should remain in the river throughout the summer period and then be removed the following winter construction season. In all cases, berm removal shall not take place during the spring spawning or migration periods. (McCart - 90,13743)

Routing

77. A general consideration for all route alignments requires that final alignment avoid, and where such outright avoidance is impossible, mitigate the impact on critical areas such as spawning, overwintering and migrating areas, areas of importance to domestic fishery and all historic or traditional fishing areas. (McCart - 93,14084; McCart - 91,13772)
78. With respect to the Mackenzie Valley portion of the proposed pipeline routes, there remains insufficient data and essential information on critical areas and potential impact. As discussed in detail under the section "Further Studies," further research on routing in the Mackenzie Valley must be undertaken before a pipeline route is approved.
79. Conclusions of the impact on the Beaufort Sea-Mackenzie Delta area are complicated by the route change to the Cross Delta alternative and the cumulative impact of the gathering facilities, enhanced oil exploration and other ancilliary activities brought on by increased activity in the area and further research is required. Conclusions to date are that the estuaries and the Beaufort Sea coast are highly protective and are critical areas in the summer months. Further studies are required to determine the population size, composition and movement of fish along the Beaufort Sea-Mackenzie Delta area. Such studies would concentrate in par- (Steigenber 103,1768)

ticular on the placing and construction of wharves so as to protect the fish resource, the implementation of special precautions and clean up techniques to protect against toxic spills into coastal waters.

80. Rivers capable of supporting overwintering fish populations are to receive special protection, discussed elsewhere. Along the north shore routes this would include protection of Craig and Fish creeks which have high oxygen readings and the Spring and Crow rivers which, although they have low oxygen readings, still appear to be able to support some Arctic fish species. (Steigenberger 103,15763-64)

81. The open water area downstream of the proposed pipeline crossing on the Malcolm River is to be investigated to determine the source of the water and establish that no sub-gravel waterflow exists at the proposed crossing which, if interrupted, would form a potential threat to the overwintering area downstream. This area is also slated as a borrow site and water supply area and the cumulative impact of these activities should form part of any assessment. (Steigenberger 103,15764)

82. Preliminary studies indicate that large rivers such as the Firth River and Babbage River may contain isolated and/or discontinuous pockets of water that are of acceptable quality to afford an overwintering habitat for fish and invertebrates. Sampling of this area for the presence of fish and food organisms is to be conducted before final route selection. (Steigenberger 103,15764-65)

83. Studies have indicated that estuaries and stream sections near river mouths support numerous diversified summer fish populations. These river mouths and the outer spits of some estuaries and lagoons are deserving of special protection. (Steigenberger 103,15765-66)

84. In considering the critical areas along the Interior Route, the Porcupine River and its several tributaries is undoubtedly of concern because of the limited area available for overwintering fish populations. The preservation of such areas along with pathways for fish migration, principally in the fall and spring months, is essential. (Steigenberger 103,15766)

85. The domestic fishery at Shingle Point and Komakuk Beach, both areas being designated for supply and stockpile sites, must be assured and appropriate techniques employed. (Steigenberger 103,15768)

86. With respect to the Firth River, information (105,16044-46) indicates that the majority of the spawning takes place 60 miles upstream in the area of Joe Creek. Although the river freezes to the bottom, further research is required to determine if there is percolation of water through the gravel and establish that proposed construction techniques and the frost bulb during operation would not interfere with this percolation essential for the maintenance of the spawning and overwintering areas.
87. Pipeline routing shall not be allowed to cross (Steigenberger 103,15773) through major spawning areas. Even areas currently defined only as probable spawning areas should not be crossed until their existence has been investigated and, if necessary, protective measures instituted. Probable spawning areas are located close to the proposed crossing sites in the Firth, Crow, Trail, Walking and Blow rivers, Deep Creek and Rapid Creek, along the Prime Route.
88. The availability of water is a concern on the (Walker - 103,15753-54) Prime route and type and extent of water removal must be carefully monitored.
89. Definitive information is lacking on each river proposed to be crossed, but such information is required. Attached as Appendix B are preliminary detailed recommendations presented by the witness, Steigenberger, with respect to each proposed crossing along the north slope of the Yukon. These particular concerns and recommendations are to be considered and implemented to ensure the protection of the fish resources.

Management and Enforcement

90. The Fisheries Act reveals that most of the provisions do not involve approval, permitting or reviewing proposals and designs. As a result, a system of final design review and enforcement of environmental protective measures by an approving authority will have to be created. (Millen - 103,15795-98)
- The authority and the requirements of the Fisheries Act should be regarded as minimum requirements. Such design review is essential because a normal engineering design does not take into account all the requirements of fish since most regulatory stipulations must allow some latitude for judgement on a site-specific basis, an appropriate design

can only be determined following biological considerations. Once the appropriate design is determined by the proponent then it is advisable to conduct a review of the design by an independent regulatory authority to ensure that the level of protection provided for the fish resource is acceptable. The enforcement system devised would combine stipulations that would allow for site-specific variation based on assessment of each stream crossing with a detailed design review process that would ensure environmental protection measures are implemented and enforced.

91. Some general rules and guidelines are very useful before final design is arrived at. This guidance, in the form of guidelines, should be provided in advance of approval to ensure the final design is within acceptable limits. The idea of an environmental code is a valuable guideline and a code, such as the Environment Protection Board's code, should be adopted and applied. However, there has to be site specific information and the exercise of judgement with respect to each significant location in addition to the mandatory requirements of a general code. The code would result in guidelines which could be deviated from in particular circumstances. An example of recommended guidelines is presented in Appendix C. (Millen, Steigenberger, Stein, Walker - 105,16058-61)
92. The greatest utilization of fish resources in the north is still through domestic fishery. Increased fishing pressure, be it for domestic or sport purposes, could reduce stock size while jeopardizing an important food source for the local people. Since, under current legislation, the government cannot deny the sale of fishing licences to anyone meeting the criteria of the Fisheries Regulations, policy enforcement is a critical factor and approval for a major construction project should not be granted until the applicant and the government agencies responsible for resource protection have reached an agreement on extent of exploitation to be allowed. There is no biological basis for present commercial fish quotas and in view of increasing demands for fish harvest it is necessary to establish quotas based on biological information. (Stein - 103,15731)

93. Recreational and sport fisheries by pipeline personnel should be prohibited. Possession of local fish should also be prohibited among pipeline personnel. (105,15987-91)

94. Both general and site-specific fishery information collected in one area, such as the Yukon north slope, cannot be extrapolated to other regions such as the Mackenzie valley. (Walker, Stein - 105,16001-0)

95. Pipeline personnel must be kept out of all areas defined as a domestic fishery. Because use fluctuates, a domestic fishery shall be defined as any area where there is some indication of use at any time over the last five years. Such areas would be completely out of bounds by non-local residents. (Wilimovsky - 107,16373-4)

96. Assuming that recreational sports fishing will be allowed after construction, increased access requires proper management. Such a management scheme must be preceded by an assessment and analysis of the recreational sport fishery of the area, subject to the controls of local hunters' and trappers' associations. (Wilimovsky - 107,16374-5 Nunavut)

97. The obvious approach is to avoid doing any significant damage to the fish populations rather than attempting to depend on restitution using fish culture techniques of one kind or another. For example, it is difficult to restore a decimated cisco population using fish culture techniques. The propagation of whitefish in general, of which cisco are a part, in hatcheries has not been successful in the past. Protection of the fish resource rather than re-stocking or re-propagating must be utilized. (McCart - 91,13936)

98. All field personnel must be provided with an operating manual which would explain, in understandable language, the procedures to be followed to ensure protection of the fish resource. Even though environmental protection measures are stated in the operations manual, continuing advice in the field should be provided by on-site biologists and the manual varied according to particular situations or past experiences. The manual should also give recommendations as to what course of action is to be followed in the event of emergency or other unexpected occurrence. (Steigenberg - 105,16097-9 42,5512-14)

Further Research

99. Identification of critical areas in the Mackenzie Valley is "far from complete". Additional work must be done on sedimentation and its effects, toxicity as it relates to northern species, northern organisms and the northern environment. It will take in the neighbourhood of two to three years, given the appropriate level of funding and manpower, to carry out the studies necessary before pipeline construction begins. (Stein - 104,15850 and 15867-69)
100. Knowledge gaps still exist in the life history details for adults and juveniles of several species. The location of spawning areas in the headwaters of tributaries remains largely unknown. Additional data must be collected on spawning habits and juvenile life histories if these critical stages are to be protected during pipeline construction. It is imperative that these information gaps be filled prior to approval and construction. (91,13913-14)
101. The type of data that is necessary has to be relevant to the type of use that is going to be made of the particular river, to be crossed or used as a water source, etc. (Hayden, Bouckhout - 100,15294-95)
102. All critical areas are to be designated as either documented or potential areas of overwintering, spawning, etc. Refinements of a quantitative nature on documented areas and additional studies on potential and/or probable or suspected areas is warranted. (Steigenberger - 103,15772)
103. Detailed examination of the open water areas and the headwaters of the Bell and the Little Bell rivers be completed as preliminary investigation suggests the Bell River, downstream of the Eagle River, contains water depths and habitats suitable for overwintering fish populations. (Steigenberger - 103,15771-72)
104. The spawning beds and overwintering areas of species such as the whitefish, inconnu, herring (in the Delta area) and the loche/burbot need to be located. (Hayden - 100,15217-18)
105. There are knowledge gaps for certain species, for instance the cisco and whitefish in some of the streams of the Mackenzie River Valley and this information should be obtained and assessed before final design is approved. (McCart - 91,13913-14)

106. Most of the major estuaries along the north slope have been studied in summer. However, estuarine environments should be surveyed, especially in the winter months, to ascertain their potential carrying capacity for overwintering fish. (Steigenberger 103,15766)
107. Lack of definitive information on each river proposed to be crossed during pipeline development is a common occurrence in most research reports. More information on scour depths, sedimentation levels, gravel resources, winter sub-gravel water flows and seasonal discharge of rivers and groundwater areas are required. In addition, it would be useful to have more information on the significance that all open water areas have in the life history stages of the fishery and invertebrate resources and the influence they have on overwintering, spawning and migration. With this further research fisheries biologists would be in a better position to evaluate various recommendations so that they can be clarified, justified and implemented to protect the fisheries resource. (Steigenberger 103,15787-88)
108. With respect to the Great Bear River, calculations have been done on the increased velocity to determine the impact on the migration of fish. This assessment is based on rock being used from the ditch excavation which would not generate significant amounts of sediment. However, in general, the amounts of sediment that are going to be released into the stream and the effect this increased sediment is going to have on the whitefish, not specifically the velocity of the stream, has not been specifically studied.
109. While the larger streams have been gauged there are a significant number of stream crossings that have not been gauged and this information should be obtained about each river crossing. Such gauging should refer not only to the rate of flow but the rate of flow against time and how discharge varies against time. This is important in measuring and considering the sediment carrying capacity of streams. (24,2810-12)
110. Because the expectation is that sediment and erosion will keep the water murky for eight months following construction of the berm in the Great Bear River the impact of this turbidity on fish must be specifically studied. (McCart - 91,13753-54)

111. Research should be conducted on what are acceptable exploitation levels allowing for the protection of the fish resource. The construction of the pipeline will result in an increased population in the north which will result in an increased demand for fish, even that fish exploited under commercial fishing licences. Regulation of the fish resource must include determination of its exploitation, on both a domestic and commercial level, as well as control of pipeline personnel. (105,15988-91; 105,16064-65)
112. There should be a further programme to collect data in areas where knowledge is incomplete to see if fish are spawning, migrating or overwintering in those areas. (Stein - 105,16055-56)
113. There should be an examination and identification of all critical areas downstream of river crossings. (90,13756)
114. If summer river crossings are to be allowed at all, research is needed to indicate the migration routes and times for the various species to be passing the crossing. If dredging or blasting is to be used, studies are to indicate how these fish runs will react to such activity. The disposition of silt, both from the trenching itself and from the spoil pile below and the impact of the berm, both with respect to hydrological effects (water velocity) and siltation need be examined. (Stein, Steigenberger, Walker - 105,16100-02)
115. There should be monitoring of fish migrations at the time of construction. Because research has observed considerable variation in the timing of migrations it is possible that such a change could happen from the norm during the time of construction. To ensure that such an atypical year does not result in severe harm to populations, constant monitoring during construction is required. (Stein and Walker 105,16112; McCart - 91,13931)
116. Monitoring of culvert crossings should be maintained to determine whether fish are being caught in culverts or entrances to culverts. (Stein and Walker - 105,16112)

117. Operational monitoring is also required to check the success of stabilization methods, monitor siltation, monitoring of gravel operations and to ensure that the policy with respect to fishing by personnel are effective. Monitoring should also be conducted at all open water and overwintering sites and water sources to monitor environmental impact. Monitoring would also indicate whether or not some protective measures are being enforced and that there is biological impact to construction decisions being made on site. (Stein and Walker - 105,16112-14)
118. Studies should be done on every tributary that is to be crossed in the Mackenzie Valley to satisfy the biologists that there are no overwintering areas not yet discovered. Also, a similar study should be done on the full downstream area below the trenching point. (Stein - 105,16077)
119. A survey should be taken at short time intervals for the major streams and lakes likely to be impacted. Instead of working on an inventory such a survey would gather information on stock size, their sensitivity and variability. Having conducted specific research on areas of critical concern, the more general research should be in the nature of an inventory. (Wilimovsky - 109,16709-10)
120. There is concern about overwintering areas that are not readily visible and their existence may not be known unless examination of the total downstream is undertaken. Rather than concentrating on a boring programme at the specific crossing sites, one must conduct a general survey down the entire downstream portion to see if particular sensitive or critical areas are encountered. Once identified, these areas must be studied to determine their significance and then recommendations made on how negative impact can meet acceptable standards. (Stein - 105,16078-79)
121. Due to the variation and limits of aquatic winter habitats care must be exercised in applying general stipulations to particular crossing sites. For example, the extent of ice formation resulting from particular climatic considerations must be assessed at the actual time and site of construction to determine whether further recommendations or protective measures are required. (Steigenberger - 103,15772-73)

Similar site-specific recommendations and changes in plans would be required in considering water utilization from groundwater sources.

122. It is important to know more about the winter ecology of fish in areas, such as the Great Bear River, where there is little domestic fishing. There is very little information about winter conditions and this information lack should be rectified. (Hayden - 100,15290)
123. With the increased pressures on the fisheries resource as a result of new development both the long-term and short-term aspects of northern development must be assessed in order to maximize benefits from the aquatic ecosystems, activities will have to be initiated or accelerated in the following areas: - (Stein - 103,15742-43)
- (a) A continuing northern aquatic ecosystem programme developed around the quantity and quality of existing data and the geographical assessment of potential industrial development plans.
 - (b) Biological monitoring programmes to determine the effectiveness of environmental protection measures.
 - (c) Fishery officers or similar environmental inspectors independent of the applicant should be on site as the development proceeds to ensure that protection measures are adhered to and to alert the operator of unforeseen resource implications. Such further research, combined with the authority and will to implement and enforce environmental protection measures is essential to ensure this project, or any other project of similar magnitude, causes the least damage possible to the fisheries resources.

THE PROTECTION OF WATER RESOURCES

The major concern in respect of the use of water in pipeline construction (not being concerned here with water pollution) is the possibility of depletion of streams or bodies of water with resulting damage to fish and other aquatic life and to birds. Removal of water from some northern lakes and streams would critically reduce the levels of unfrozen waters in fish overwintering areas. Removal of snow from frozen lake surfaces could reduce the insulating snow cover on the lake and cause the lake to freeze to a deeper level, reducing the fish overwintering habitat. Removal of water from northern lakes and streams could lead to the de-stabilization of the shores with resulting increase in erosion and siltation and detriment to fish and other aquatic populations.

If either of the Arctic Gas routes across the Yukon North slope are used, successful prevention of the kind of problems mentioned above will require close regulation, and very detailed site-specific investigations to ascertain the exact effects of the intended withdrawals of water.

RECOMMENDATIONS

1. The bodies of water from which water may be drawn must be strictly regulated and specific approval granted for the use of each source of water as contractors can be expected to use water from the nearest source. (85A, 12745; Stein 103, 15729-30; Williams 25,12630)
2. To obtain approval for the use of a water source the pipeline company should have to: (Stein 103, 15729-30; McCart 84,12557-71)
 - (a) submit information identifying the proposed source, the volumes required and the time period over which water will be extracted.
 - (b) conduct thorough biological and hydrological estimations of each system especially under winter conditions.
 - (c) provide documented proof that lakes indicated as being fishless are indeed not utilized by fish at any time of the year.

- (d) submit evaluations and predictions of the biological and hydrological implications of water extraction from each system including such information as the anticipated effect on the water level, whether any spawning areas would be exposed and other similar habitat evaluation.
3. The pipeline company must avoid withdrawing water from waters which are important for benthic and burbot populations and which might be depleted or otherwise adversely affected by such withdrawal, as an adverse effect on those populations might indirectly adversely affect fish populations. (McCart 84,12557-71)
 4. The pipeline company must not deplete bodies of water important to bird populations. (McCart 84,12557-71)
 5. The pipeline company should use large lakes and rivers for its water sources as a general rule, but usage should be based on individual investigation of lakes and on assessments of their utilization and productivity. The pipeline company must calculate the discharge in rivers and the volume in lakes in assessing the choice of water sources. (Steigenberger 103,15780-83)
 6. The pipeline company should not withdraw water from all rivers and streams where there are overwintering fish populations, or spawning areas downstream from such areas. If a pipeline is to be built along the Yukon North slope, no water is to be withdrawn from any rivers or streams that have flowing water at any time of the year. (85A, 12753-57; Steigenberger 103,15780-83)
 7. If it should be absolutely necessary to remove water from critical sites, removal should be allowed only at a rate in proportion to discharge that will not change its ability to maintain the present population of fish. (Steigenberger 103,15780-83)
 8. Water intakes must be screened, placed in a porous berm, or fixed in a buried container to prevent the entry of fish into the intakes. (Steigenberger 103,15780-83)

9. Snow harvesting from lake surfaces must be limited to lakes, or areas of lakes which are frozen to the bottom, unless it can be shown that removal of snow from the lake surface would not result in the ice freezing down to a level which might be detrimental to fish or other aquatic populations. (Jarvis 66,9819-27)
10. Site-specific studies should be undertaken to determine the effect on water bodies of the removal of snow by snow-harvesting, especially upon fish populations. (Jarvis 67,9859)
11. Studies of water availability, the effect of water use on water bodies and studies to calculate the amount of water which may safely be withdrawn from fish areas, from such data as fish population, distribution of fish eggs in the gravel, depth of water, velocity, and cross-sections of streams should be required on a site-specific basis. (McCart 84,12557-71 85,12622; Weedon 75, 11100-04; McCart 85A, 12753-57, 12760-61)

WASTE DISPOSAL

The regulation of waste disposal during pipeline construction includes the treatment and disposal of domestic sewage from the work camps, the disposal of garbage and other solid wastes from the camps, and from construction operations, the transport, storage and disposal of toxic chemicals including refined petroleum products, the design and safety of sumps for the disposal of drilling fluids during oil and gas drilling operations, and the disposal of waste soil from construction operations.

There is a general consensus that sewage from construction camps must be satisfactorily treated, and that disposal of sewage should only be allowed if it is in compliance with government standards. However, there seems to be no agreement on the best methods of sewage treatment to be used, a physical chemical process of water treatment, (Minning 78, 11649) or a mechanical treatment plant with a back-up lagoon system. (Lawrence 88, 13234-52). There is some controversy over the use of sewage lagoons in permafrost rich areas, as there is a danger of the degradation of the permafrost under the lagoon and a subsequent failure of the lagoon system. But there is agreement on many of the proper design features of a lagoon, or the restoration after abandonment and that various back-up systems and equipment must be provided for each sewage treatment system. There is agreement that chlorination of effluents should be avoided when the effluent may contaminate a domestic drinking supply as chlorination delays the natural processes of biological decay of wastes to harmless substances.

Certain problems which arose in Alaska, in construction of the Trans-Alaska Oil Pipeline, can be avoided by designing sewage treatment systems with sufficient capacity, and with a capacity to be expanded if sumps are to be larger than expected.

With very few exceptions the matter of the proper standards and methods of solid waste disposal seems uncontroversial. Generally, it seems agreed that burnable wastes shall be incinerated and that other solid wastes shall be buried in approved sites or re-cycled.

The danger of attracting wolves, bears and other animals by leaving edible garbage out is mentioned by many experts

(McTaggart-Cowan 47,6221-22) and immediate or at least daily incineration of such wastes, and the fencing off of camps and incineration areas is required. Animals that are attracted to camps by garbage, or by deliberate feeding, become a danger. Thus, it is essential for the protection of the wildlife that recommendations on disposal of garbage be strictly followed.

Solid non-combustible wastes should be buried unless they can be re-cycled, as can for example, oil drums which should be returned to their place of origin.

Large quantities of refined petroleum products (gasoline, diesel fuel, oil, etc.) and toxic chemicals such as methanol, drilling mud components, sewage treatment chemicals, and others must be transported, stored and disposed of during pipeline construction. The quantities of such substances, the pressure upon transportation facilities and the need to construct largely all new storage facilities, make the problems very difficult. So too will the difficult working conditions during winter construction make accidents more likely. As a result, there is a need for special safeguards in handling these materials.

Problems of spills from defectively designed drilling sumps can be minimized by the recommendations below.

Large volumes of waste soil may be generated from pipeline construction on the right of way, and must be disposed of in a way that will prevent the soil from subsequently becoming unstable and slumping into nearby water courses, or unduly eroding and being washed into water courses.

RECOMMENDATIONS

Sewage Treatment

1. The pipeline company must consult with local communities well ahead of time to determine the type of facilities for sewage and water needed in the communities to ensure quality and safety of local water supplies and local community preferences can be followed. (Burrell C-21, 2156)
2. The final choice made as to sewage treatment methods in the case of camps, whether the use of lagoons, with or without package treatment plants, using the physical chemical process, or the biological or activated sludge process, or the use of swamplands must be based on (Lazerte 63,8991-92)

the most stringent water quality standards, and safety requirements.

3. The use of swamplands for the release of effluents from sewage lagoons must be carefully controlled, and be limited to the summer period when lagoon treatment is at a high level. The effluent to be disposed of in this way must be tested to ensure it meets the standards set by regulatory agencies. (Lazerte 63,8991-92)
4. Lagoons must be designed to contain at least ten days of total flow with ample allowance for ice formation. (Minning 78,11649)
5. Discharges from backed-up lagoons must be made into swampland or heavy bush and not directly into water courses. (Minning 78,11649)
6. Discharges directly into bodies of water and especially into running water are to be prohibited. (Minning 78,11649; Lawrence 86, 12979-83; Millen 103, 14790)
7. Chlorination of effluents should be prohibited except where there is a possibility of contaminating a domestic water supply. (Minning 78, 11649; Lawrence, 86, 12979-83)
8. Sewage sludge resulting from secondary treatment processes should be incinerated. (Minning 78,11649)
9. Unless further study should show a clear advantage for a mechanical treatment plant system, the physical chemical process of water treatment may be used, using chemicals to precipitate solids with subsequent disposal by incineration, and secondary treatment by incineration, subject to meeting approved standards of water quality and safety. (Minning 78,11649)
10. A mechanical treatment plant with a back-up lagoon system may be used subject to meeting approved standards of water quality and safety. (Lawrence 88,13234-52)

11. Sewage lagoons may only be constructed in permafrost- rich areas where specific studies and designs have been undertaken and approved, and which show that the terrain stability and the lagoon integrity may be maintained. (Lawrence 88,13234-52)
12. Bermed type construction of sewage lagoons must not be used on ice-rich permafrost soil. (Lawrence 88,13234-52)
13. Studies and designs for the satisfactory restoration of areas used as retention ponds must be submitted before approval of such ponds. (Lawrence 88,13234-52)
14. If mechanical treatment plants are to be used, the applicant must ensure that personnel to operate the plants will be adequately trained for that purpose. (Lawrence 88,13234-52)
15. Back-up units for mechanical treatment plants must be installed. (Lawrence 88,13234-52)
16. The sewage treatment systems must be designed with a duplication of essential equipment, such as two blowers on a biological unit.
17. Retention ponds at compressor sites should be left in existence to serve as a complete treatment unit for continuing operations, in addition to holding tanks left at the compressor sites.
18. When lagoons are abandoned, berms should be spread or removed, and flattened. It should then be covered with material that would allow natural growth. There need be no attempt to remove all the sludge, but the liquid should be drained off.
19. Effluent should not be deposited in wetlands inhabited by beaver or muskrat. (Lawrence 13234-52)
20. Sewage lagoons must be designed using a multi-cell type of design allowing for a deposition of sludge, a separation of sludge, plus a sufficiently long retention so a secondary treatment could take place. (Lawrence 87,13118-19)

21. Sewage treatment equipment, and facilities used during construction but surplus to operational needs, should be offered on a right of first refusal basis to northern communities. Other equipment should be removed for recycling. (Lawrence 86,12879)
22. Camp sewage treatment systems shall be designed such that they can be easily expanded if the camp size should be enlarged. (Lawrence 86,12979-83)
23. Camp sewage treatment systems should be designed with excess capacity. (Lawrence 86,12979-83)
24. Liquid wastes originating from the wash of laundries and kitchen facilities must undergo secondary treatment. (Stamberg 115,17544-55)
25. A final design review of sewage treatment facilities must show that there is a satisfactory contingency plan if bypassing the sewage system in an emergency is necessary. (Lawrence 86,12687-88)
26. Back-up portable pipeline systems must be provided for each sewage treatment facility. (Lawrence 86,12687-88)
27. Sewage effluent must be regularly tested to ensure that it complies with government water standards. (Hurd 40,5237)
28. The Environment Protection Board recommendations in Section 23 of the Environment Protection Board code should be adopted, unless a higher standard is urged herein. (McTaggart-Cowan 47,6221-22)

Garbage

29. Unless a higher standard is urged herein, the Environment Protection Board recommendations in S. 23 of the Environment Protection Board code should be adopted. (McTaggart-Cowan 47,6221-22)
30. All edible and combustible wastes should be incinerated immediately or at least daily and non-combustible waste should be buried. (Hurd, 41, 5364-65; McTaggart-Cowan - 47,6221-22)

31. All food shall be stored in a manner that will not attract wildlife. (McTaggart-Cowan 47,621)
32. No person may feed wolves, bears or other wildlife. (McTaggart-Cowan 47,621)
33. Camp areas should be fenced to prevent wild animals being attracted by the smell of food, or garbage. (Jakimchuk 95,14360-66)
34. There must be extra incinerating equipment available in case of a breakdown or in case of an extra heavy amount of garbage. (Jakimchuk 95,14360-66)
35. Waste disposal must be effective enough to ensure that bird populations do not become semi-domesticated and more numerous than is desirable. (Gunn 39,13442)
36. Mobile incinerators should be available along the construction right of way for the incineration of loose garbage. (Lawrence 88,13252-54)
37. Incinerators should meet government standards for air pollution.
38. Non-organic waste and the residue from incineration of organic wastes should be buried at approved sites, using approved methods. (Lawrence 88,13252,58)
39. Oil drums should be returned to place of origin. Pieces of equipment and machinery with a value for reclamation should be hauled to control designated areas near the Mackenzie River for re-use, or sale, or processing. (Hemstock 81,12085-87)
40. Pipeline condensates must be safely disposed of, by incineration if that does not result in release of undesirable vapours into the atmosphere. (Lazerte 63,9059)
41. Unused vehicles, oil drums, and machinery must not be abandoned, but rather hauled out, for approved disposal. (Faulkner 115 17507)

Transport, Storage and Disposal of Toxic Chemicals

42. Disposal wells should be cautiously used for the disposal of toxic chemicals. (Shaw 119,18187)

43. Storage facilities for refined petroleum products and potential toxicants should be surrounded by impervious dykes. (Steigenberger 103,15776)
44. Hoses, nozzles and all dispensing equipment should be continuously inspected for leaks and spills. (Steigenberger 103,15776)
45. Storage and transport of refined petroleum products in the field should be done no closer than 1/4 mile from a stream. (Steigenberger 103,15776)
46. No toxic chemicals may be disposed of outside of designated areas. (Steigenberger 103,15776)
47. No containers for toxic chemicals should be washed in streams or lakes. (Steigenberger 103,15776)

Drilling Sumps

48. Drilling sumps must be carefully engineered to prevent failure of the sump, especially due to thawing of permafrost. (Mainland 114,17284)
49. Drilling sumps must be of a sufficient size to contain all drilling fluids with sufficient freeboard that spills cannot occur. (Barry 122, 18577-78)
50. Drilling sumps must be engineered and located so that waters cannot enter the sump and wash toxic wastes into water courses. (Barry 122, 18577-78)

Waste Soil Disposal

51. Waste soil from contour changes in construction should be used on the right of way. (Williams 83,12509-16)
52. Where substantial volumes of excess material cannot be disposed of on the right of way, they should be hauled away to approved disposal sites. (Williams 83,12509-16)
53. Organic, or any other fine material, should be disposed of off the right of way where it could not enter natural waters. Such materials should only be disposed of on a slope where it is done in such a way that no significant amount of sediment can be washed into natural water courses.
54. Waste soil must not be disposed of on ice over water courses. (McCart 84,12526)

APPENDIX "A"

PARLIAMENT

Minister

The Authority

- 1) Federal Government
- 2) Territorial Government
- 3) Native Communities

Authorized Officer

In House Staff
-Adm. Manager
-Engr. Adv.
-Scientific Adv.

Ombudsman

Advisory Board

NWT Rep.	COPE
Yukon Rep.	NWIIB
DINA	CARC
DOE	CWF
EMR	Yukon Ind
Local Comm. Rep.	The Compa

Staff

Secretariat and Staff

Authorized Officer's
Field Representatives

Third Party Contractor

Design Review
Administrative Services
Technical Expertise
Scientific Expertise
Field Inspectors

APPENDIX "B"

PRELIMINARY SITE SPECIFIC RECOMMENDATIONS FOR THE PROTECTION OF THE FISH RESOURCE DURING CONSTRUCTION OF A PIPELINE ALONG THE NORTH SLOPE OF THE YUKON TERRITORY.

CRAIG CREEK

1. Deep burial of the pipe will be required beyond the west riverbank to ensure that the pipeline does not become exposed by lateral shifting of the river. It is unknown how much shifting might occur within the operating lifetime of the pipeline, but as a safeguard, the pipe should be extended westward at its minimum design elevation for at least one full flood plain width or approximately 600 feet.
2. Water and gravel removal in the vicinity of the open water area should not be permitted until documentation of the importance of the area to fish and invertebrate survival has been completed in greater detail. More detailed information is also required on fish migrations, invertebrate usage, productivity and sensitivity. In addition, the groundwater source, recharge area, discharge and sensitivity of the winter open water area to construction activities needs to be clarified.

BACKHOUSE RIVER

3. Since this stream is relatively small and contains no open water areas, it is considered that winter pipeline construction will have little or no effect on the fishery resources. Erosion control measures should be planned along the pipeline right-of-way to prevent increased sedimentation during the open water season.

FISH CREEK

4. Komakuk Beach is proposed as a major year-round staging area for pipeline activities. Conflicts may arise between construction and the present recreational, and domestic harvest, the life stages of Arctic char, and invertebrate food sources. Specific construction activities include a staging area, water removal, gravel removal, storage areas, tank farms, camp sites, and waste disposal. Each of these activities should

be designed or scheduled to avoid conflict with life history stages of Arctic char and prevent a decrease in the productivity of the fish and invertebrate food sources. Some additional studies will be required.

5. An aufeis area and groundwater source exists downstream of the proposed pipeline crossing. The source of water, discharge and recharge area is unknown. The extent and winter utilization by fish and invertebrates is unknown. Creel data suggest that there exists some doubt whether all the fish overwinter upstream of the proposed pipeline crossing. Construction activities may interrupt the water flows. Closer examination of aufeis area and groundwater source is probably warranted. Water utilization other than that already being used may be prohibited.
6. Sedimentation from the right-of-way after construction must be maintained at a level below that which would affect invertebrate populations which are the source of food for rearing fish. In addition, sedimentation of the downstream groundwater source should be prevented.

MALCOLM RIVER

7. The trenching of the ditch across the Malcolm River must not intersect subgravel water flows that may be providing the water supply to the aufeis area downstream. Ice heaves upstream strongly indicate the presence of subgravel flows. A drilling programme should be conducted in subsequent winters to ensure that the stream is frozen solid prior to the trenching operations. If subgravel flows are present alternate construction techniques and/or special trenching methods must be instrumented to prevent the freezing of the open water area downstream of the proposed crossing.
8. Stabilization and erosion control measures will be required along the east bank to suppress lateral movement of the river.

9. The final design minimum invert evaluation of the pipeline within the active flood plain should be extended for 1 1/2 miles through the inactive flood plain on the west side of the active channel. This will ensure that the pipeline is not exposed as a result of future realignment of the river.
10. More information on spawning in the Malcolm River is required. Some evidence suggests that small numbers of Arctic char may spawn in the river. The spawning area must be delineated. If spawning occurs upstream or downstream of the proposed pipeline crossing additional information on population sizes and migration routes and timing would be required. If spawning occurs downstream in the open-water area, increased sediment levels associated with all phases of construction would have to be minimized to ensure the survival of all life stages of fish and invertebrates. In addition, it may be necessary to prohibit the utilization of water from the open-water area.

FIRTH RIVER

11. The trenching operation may intersect subgravel waterflows that are maintaining fish populations further downstream during the winter. Alternate construction techniques and/or special trenching methods should be investigated to prevent excessive overflow and decreased subgravel waterflows, excessive ice buildup, and increased sedimentation during the critical winter period. These events may influence the survival of fish and/or fish eggs, the timing of breakup and the migration of fish. Sedimentation must be kept to a minimum during the winter and year-round erosion of the right-of-way must be low enough to reduce the productivity of the invertebrate food sources that maintain the fry, juvenile and adult life stages of fish populations that utilize the delta during different times of the year.
12. As in the case of the Malcolm River, an alluvial fan occurs in the lower reaches of the Firth River which appears to be migrating eastward. However, the proposed pipeline crossing is located upstream of the fan and should not be influenced by this migration.

13. Documented and potential overwintering environments, spawning grounds, and an important rearing area (channels in the delta and estuary) are all downstream of the proposed pipeline crossing. In addition, the river is a major migration route. Additional information on the importance of the aufeis area for overwintering of fish populations downstream of the crossing is required.

SPRING RIVER

14. Protection measures will be required in the form of riprap or deep burial of the pipeline for several hundred feet westward of the flood plain to guard against further erosion of the left bank. Alternatively, the pipeline could be relocated to a more stable section of the river.
15. The proposed pipeline crossing is located upstream of the aufeis area which formed during the winter of 1974. However, further inspection of this area should be carried out during subsequent winters to determine whether any subgravel flow exists between the two aufeis areas as well as defining the extreme upstream limit of ice formation and the location and extent of the ground water sources. The sensitivity of these areas to winter construction is unknown. If subgravel flow is intersected during the trenching operation, special techniques may be required to prevent excessive overflow and freezing downstream of the trench.
16. The Spring River is proposed as a gravel source. Closer examination of the river with timing of migration of fish and the presence of undetected overwintering sites should be clarified. Alternate gravel sources should be considered if the investigations indicate that this area is ecologically important.

CROW RIVER

17. Protection measures will be required at the proposed crossing in the form of riprap or deep burial of the pipeline for several hundred feet eastward of the flood plain to guard against further erosion.

18. Since the aufeis area is downstream of the proposed crossing, sedimentation of the area during the winter may be extremely severe if subgravel waterflows are intersected during the trenching operation. Like other ground water sources in the area it is important to collect data that are more complex than collecting and analyzing water samples. Discharges, water sources, water qualities and recharge areas should be collected at different times of the year especially in the critical winter period.

BABBAGE RIVER

19. Erosion control measures at the proposed crossing must be adequate to prevent increased sedimentation from erosion along the right-of-way that may reduce the productive capabilities of the river. This is particularly important with regards to the ice-wedge polygons on the west bank of the river.
20. The trenching of the ditch across the Babbage River will probably intersect subgravel waterflows. In preparation for construction alternate techniques and/or special trenching methods must be developed to prevent ice build-up during construction that may result in excessive ice scour during breakup.
21. The information on the life history stages of hump-back and broad whitefish in the Babbage River is limited. Is the presence of these fish in the vicinity of the proposed crossing merely a seasonal migration or does the river afford some other parameters which is critical to some phase of the life cycle (such as spawning)? The utilization and the importance of isolated pockets of water under ice to life stages (adults, juveniles and eggs) of fish and invertebrates is unknown.

TRAIL RIVER

22. No groundwater sources have been observed in the Trail River. During the winter the proposed crossings have been frozen to the gravel. Superficially, the area appears to be a low risk area for winter construction, however, a drilling programme would be advisable.

23. Since the river is proposed to have a fairly intensive gravel removal programme, some additional information may be required to determine more accurately the timing of fish migrations. Increased sedimentation during the spawning and rearing period must be minimized.
24. Erosion control and stabilization measures will be required to prevent further bank recession and subsidence of the ice wedge polygons in the vicinity of the crossing on the east side of the river.

DEEP CREEK

25. An adequate depth of cover over the pipe within the river channel and proper stabilization and erosion control measures on the relatively steep east bank are required. Consideration should be given to access problems in the final design stages.
26. More information on the importance of interconnected lake to the overall productivity of Deep Creek (recruitment of fish and invertebrate food sources) should be collected.

WALKING RIVER

27. As a safeguard against possible future channel re-alignment, the pipeline should be deeply buried over the full width of the meander belt. This would be over a distance of approximately 2000 feet westward from the toe of the ridge along the east side of the river.
28. The presence of what appears to be a possible archaeological site upstream of the proposed crossing needs clarification.

BLOW RIVER

29. The proposed erosion control measures such as berm breaks and diversion dykes on the banks of the Blow River may prove to be inadequate. If it cannot be shown that these measures will be effective in controlling erosion along the steep section of the pipeline right of way, consideration should be given to relocating the pipeline route, possibly upstream from its current location. Regular maintenance and monitoring of this crossing should be mandatory.

30. The trenching of the ditch across the Blow River may intersect subgravel water flows. A drilling programme should be conducted to assess the problem. If subgravel flows are present alternate construction techniques and/or special trenching methods may be necessary.

RAPID CREEK

31. An adequate depth of burial below the active flood plain is required to ensure the pipeline crossing presents no major fisheries problems. Regular surveillance of this crossing is warranted to ensure that riverbank erosion does not expose the pipeline.

POTATO CREEK

32. Erosion control measures must prevent the long-term impacts associated with increased sedimentation from degradation of the right of way.

SURPRISE CREEK

33. Erosion control measures must prevent the long-term degradation of the environment by increased sedimentation from the right of way.

SCHAEFFER CREEK

34. Erosion control measures must prevent the long-term impacts associated with increased sedimentation from degradation of the right of way.

WATERS RIVER

35. The pipeline should be buried at its minimum invert elevation for a considerable distance eastward of the main river channel to protect against possible re-alignment of the river. Further surveys may be necessary to define the eastward limit for maximum burial depth.
36. Erosion controls must prevent the long-term degradation of the right of way.

BERRY CREEK

37. Stabilization measures will be required along the west riverbank at and upstream of the proposed crossing to prevent further migration of this meander bend.
38. The significance of isolated pockets of water under ice in the vicinity of the proposed crossing needs clarification.
39. Sedimentation from the right of way must be minimized to prevent a decrease in spawning and rearing capacity of the creek downstream of the proposed crossing.

OLD CROW RIVER

40. Erosion control measures must prevent increased sedimentation of the Old Crow River in that it may effect the timing of upstream migration in the spring prior to breakup and the productivity of the river as a major rearing area.
41. Timing of construction should not conflict with timings of major fish migrations (upstream and downstream). Construction should be limited to that time of the year when impact will be minimized. Cursory information indicate that from January to early March may be the preferred time of the year.

DRIFTWOOD RIVER

42. Gravel removal and trenching of the river crossing should not interrupt the subgravel waterflow in the mainstem of the river as this may endanger potential overwintering areas downstream. Consideration should be given to alternate and/or special construction techniques if subgravel flows are intersected.
43. The pipeline should be extended eastward to the minimum invert elevation for a considerable distance to prevent exposure of pipeline by lateral shifting of the river.

RAT INDIAN CREEK

44. Erosion measures must prevent the long-term degradation of the right of way resulting in increased sedimentation of the creek which may influence the rearing capacity of the creek.

APPENDIX "C"

RECOMMENDED SAFEGUARDS DURING PIPELINE CONSTRUCTION, OPERATION AND ABANDONMENT TO PROTECT THE FISH RESOURCE.

DESIGN PHASE (Including Design of Both Construction and Abandonment Procedures)

1. Approving Authority should approve the location of specific crossing sites before pipeline construction. This might enable selection of sites where important fish habitat would not be disturbed or where sedimentation and erosion would be reduced.
2. Plans for construction near all water bodies should be submitted to Approving Authority for approval at least one year before construction. The plans should include the pipeline design at proposed crossing sites as well as the proposed construction techniques and schedules.
3. All drawings and instructions for construction should have a fisheries protection clause written on them so that contractors know that departures from the plan which would affect fish must be approved by Approving Authority.
4. When upstream migrations or spawning grounds are threatened, it may be necessary to provide dry crossings for construction equipment during terrestrial construction.
5. Construction of water crossings should be scheduled to avoid any conflict with the fish of the area; construction may be prohibited at certain times and locations.
6. The pipeline design and construction methods should minimize the amount of material which would erode from the construction area and flow into any water body. Appropriate design and methods would depend upon the local soil condition, terrain, ground cover, side slopes, and weather conditions.

7. All underwater crossings should be excavated sufficiently deep that the pipe will be buried below the maximum anticipated depth of bed scour.
8. It may be necessary to backfill trenches in rivers with rocks or washed gravel when replacement of the excavated material would cause excessive siltation.
9. At some stream or river crossings, temporary wiers or cofferdams may be required to form sediment settling basins. It may be necessary to remove the sediment from some basins during construction and all sediment in the basins must be removed after completion of the crossing.
10. Stream diversion or channelization should not be allowed without a permit from the Approving Authority.
11. The following restoration should be undertaken after the pipeline installation across a water body has been completed: many of the temporary construction features should be removed; the original configuration of the stream should be restored; all debris and unused construction material should be removed from the crossing site. The methods and timing of restoration should be approved by Approving Authority.
12. To prevent sloughing and erosion, river banks are to be stabilized in a manner appropriate for each site. Materials and procedure are to be approved by Approving Authority.
13. Effective erosion control features are to be installed along the pipeline right of way. The nature of these devices would depend upon the characteristics of the soil and terrain and should be approved, in advance, by the Approving Authority.
14. Construction plans for roads and equipment pads, or other construction features near streams should be approved by Approving Authority. Gravel or rock for such construction should have a low sediment content.
15. During construction at some crossing sites, it may be necessary to provide fish passage facilities to prevent delaying or impeding the migration of fish.

16. Gravel removal should not be allowed near any water body or from any stream bed without a permit. Gravel might be removed from the flood areas of certain streams or rivers, but not from below the existing water level outside the main channel. All areas of gravel removal must be graded so that they would not trap fish when the water level recedes after periods of high water.
17. Subject to Approving Authority approval and the following conditions, water may be removed from rivers or lakes for testing or cleaning the pipeline:
 - (a) the water supply at the proposed site must not be reduced below acceptable standards;
 - (b) the water intakes must be screened with material approved by Approving Authority;
 - (c) water discharge from the pipe must not cause excessive erosion. Discharge into water bodies would not be permitted if the water in a pipe might contain significant quantities of toxic chemicals or novel species of fish;
 - (d) siltation is to be minimized during water intake and discharge, and must meet accepted standards.
18. Fuel storage areas must be dyked with impervious material, located away from the water, and sloped away from water when possible.
19. Approving Authority approval should be required for use of all toxic chemicals.
20. Effective contingency plans should be a requirement for the use of any toxic chemical. The appropriate personnel must be well informed about all contingency plans.

CONSTRUCTION PHASE

21. All construction procedures must follow the plans approved by Approving Authority. The fisheries officer on site must be notified about any departures from the plan far enough in advance to evaluate the alternatives.

22. All companies involved in construction of the pipeline must use methods which will minimize erosion to an acceptable standard of siltation for all water bodies near the right of way.
23. Attempts should be made to develop standards for suspended sediment level during and after construction. The standards would be based on bioassay experiments and might be different for different seasons of operation. The standards for different crossings might vary depending upon the fish species and habitats which would be affected. During construction, changes in procedure may be necessary in order to meet the standards; after completion of the pipeline, additional erosion control features may be required to meet the standards.
24. All equipment or machinery used in construction should cross rivers and streams at a single location approved by the fishery officer on sight.
25. No excavated material or construction material should be deposited in water bodies or in a location where it would enter them during periods of high water.
26. Blasting below high water level may not be undertaken without approval of Approving Authority.
27. Water removal should be allowed only under permit. Such control is necessary particularly during the winter when the amount of suitable fish habitat is very limited in extent. All water intakes must be screened with material approved by Approving Authority.
28. Plans for any water to be transferred from one water body to another must be acceptable to an approval authority.
29. All effluent should be tested and must be of an acceptable standard.
30. Use of pesticides should not be allowed.
31. No waste chemical, garbage, or sewage disposal should be allowed in water.
32. In some cases, pipeline construction on land may be undertaken before construction of river crossings. To prevent siltation, pipeline excavation should be

stopped three to 40 meters from the wetted perimeter of rivers or streams. The exact distance from the bank should be determined by the individual characteristics of each crossing site.

OPERATION PHASE

33. The same precautions as during construction should be required for: use of chemicals, disposal of waste, and storage of fuel.
34. Periodic inspection should be made of all stream crossing sites during operation of the pipeline. Where necessary, additional erosion control features should be implemented.
35. The integrity of the pipe should be inspected to ensure that its strength is not significantly reduced by corrosion or damage.
36. Contingency plans should be revised and improved continuously to take advantage of new material and procedure for clean-up.

ABANDONMENT PHASE

37. The same precautions as during construction should also be enacted during abandonment. The plan for equipment, procedure, and scheduling should be approved by Approving Authority.

